amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA

OCTOBER, 1972

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1T4 (DF91)	2.13	6G8G	3.06
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6AM6 (EF91)	2.28	6SO7	3.18
6AN7A (ECH80)	1.90	6U7G	0.75
6AN8	3.06	6V4	1.10
6AR7GT	2.28	6V6	3.64
6AU4GT/A	1.84	6X2 (EY51)	2.40
6AU6	1.61	6X9 (ECF200)	2.09
6AU7	2.87	6Y6G	3.10
6AU8	3.06	6Y9 (EFL200)	2.30
6AV6	1.35	12AT7 (ECC81)	0.75
6AW8A	1.93	12AU6	1.78
6AX4GT	1.84	12AU7A (ECC82)	1.72
6B8	3.83	12AX7 (ECC83)	1.95
6BD7 (EBC80)	1.90	12BE6	2.02
6BE6 (EK90)	1.69	12SN7GT	3.18
6BH5	1.61	16A5	2.15
6BV7	1.61	16A8 (PCL82)	2.46
6BW6	2.25	17Z3 (PY81)	2.25
6BW7	2.28	30	0.30
6BX6 (EF80)	1.61	KT66	6.30
6BZ6	1.61	KT88	7.05
6CA7 (EL34)	3.58	6148 (QV06-20)	7.29
6CM5 (EL36)	2.65	QA2/150C2-4	1.46
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6CQ8	1.69		

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CONTENTS

COVER

These two Cubs from the 1st Glen Waverley Group were caught getting in some early practice at a local Amateur shack for the 15th Jamboree-on-the-Air to be held on 21st-22nd October, 1972.

(Photo VK3ZU)

QSP

The Net Frequency Syndrome

One of the unique aspects of the Amateur Service is the ability of an operator to select his own working frequency within the allocated band. Most other Services are confined to spot frequency or net operation and it is only since the advent of s.s.b. on h.f. and carphones on v.h.f. that this net frequency type of operation has become popular amongst Amateurs. By its nature, net operation is a community affair and as such, certain disciplines must be exercised if all are to enjoy the benefits of the net. However, with people being people, there will always be someone to cause a disturbance by not abiding by the necessary disciplines—a "net nit". "QST" had something to say about this problem recently.*

"All of us take a crack at psychology at one time or another, in one way or another and in the case of deliberate repeater or simplex frequency interference we can look at it two ways. One is from the stand-point of the person causing the interference—a person whose sick mind is intent on attracting attention to himself in this manner. Just as the deliberate interference is irritating to those affected, **deliberate** and **studied** ignoring of it is irritating to the person doing it. Initially such an action will result in making it worse as the maniac intensifies his efforts to call attention to himself. Ignore him—don't even mention his presence on the air—don't even admit that you are hearing him. Creeping frustration will result and eventually, if you stick to your guns he will go away, possibly to cause interference elsewhere where he can get some attention—or perhaps ride naked down the street on a motorcycle.

"The second way of looking at the interference problem is from the stand-point of the people on the receiving end of the interference. The interfering operator may be called an idiot, a moron, an imbecile, is threatened, vilified and in every way possible is let know that his efforts to disrupt the net are being **successful**—this by operators on the net who want to call attention to **themselves**. For example, an operator may take over the net frequency and tell the interfering operator off, another invites him to call on the phone and even reverse the charges, still another offers to pay the interfering station so much an hour to stay on the air so that monitors can triangulate. This delights the interfering operator by satisfying his ego and at the same time makes the other operators feel big also because they are doing something about it. But what do these actions and reactions do for the public image of Amateur Radio?

"So if someone does get on a net frequency for the avowed and admitted purpose of causing interference, there are only two ways to get rid of him. First by ignoring him. If that doesn't work, perhaps monitors can be brought into the act. Neither of these methods is instantaneous and neither is foolproof, so the third thing to do is simply to grin and bear it, and remember that it takes all kinds of people to make a world—and Amateur Radio."

D. H. RANKIN, VK3QV,
Federal Vice-President, W.I.A.

* Adopted from "QST" for April 1972 with acknowledgments to W1NJM, W4IIA and W0CRO.

Stop Press: AO-C now due to be launched on October 15 or 16

COMMUNICATING: WHY NO "A.R."?

Amateurs seem to be notorious about communicating changes of address, call sign or other essential details to their Division and/or to "A.R." Each month an average of about 10 "A.R's" are "returned to sender" by the Post Office. When this occurs the mailing service is told to remove the address plate forthwith. It stays out until a new address comes to hand. Please advise any address, call sign or other changes promptly and indicate whether the change of address applies to "A.R." only or to the Call Book as well.

ANOTHER SPECIAL PREFIX

In a letter from A.R.S.I. advice is given that the Indian authorities have allocated an optional call prefix VU2S to Indian Amateurs for the period 15th August to 31st December, 1972, to mark the 25th anniversary of Independence.

HANDY BEARING CHARTS

William D. Johnston, WB5CBC, writes in an article to "A.R." about the availability of computer charts for forward and reverse bearings between any two or more places on the face of the globe. The present availability of great circle maps based on various Australian centres is good, but if anyone would like more details please write to the author at 1208 Pomona Drive, Las Cruces, New Mexico, U.S.A., 88001.

MICROWAVE BAND LETTERING

In response to the August QSP on this subject ("Those Lettered Bands"), VK2ZKQ writes about the confusion which exists in the lettering system in use. From the tables included with his letter, it seems desirable to talk about frequency ranges in terms of GHz. until the various ranges become specifically identified or universally accepted in abbreviated forms.

RECIPROCAL LICENSING

In clarification of the correspondence published in August 1972 "A.R.," page 17, the P.M.G. Radio Branch has confirmed in writing that the "attached statement" refers only to overseas applicants visiting Australia for a temporary period exceeding 12 months or who intend to settle permanently in Australia. It was also confirmed that visitors issued with a "temporary" period licence shall be subject to Australian terms and conditions applicable to the kind of licence (e.g. Full or Limited) they possess.

STUDENT EXCHANGE

Plans have been finalised with A.R.R.L. to send two Indian Radio Amateurs for training in the U.S.A. on Amateur Radio for a period of about six months. The trainees pay their own fares to and fro but "expenses in the U.S.A. will be arranged by A.R.R.L." on this first phase of the "pilot" scheme. (Indian Radio Amateur, Feb. 1972.)

Using the Plessey SL600 Series Integrated Circuits in Transceivers

JAMES M. BRYANT,* G8FNT

• The SL600 series comprises r.f. and i.f. amplifiers with low cross-modulation and good a.g.c.; a.f. amplifiers with and without a.g.c.; high performance balanced modulators; speech a.g.c. generators; and a complex circuit containing a.m. and s.s.b. detectors and a c.w. operated a.g.c. system.

This article describes some transmitters and receivers that can be built from SL600 devices, but does not cover either the audio sections (except as they may affect the operation of the rest) or, in the case of transmitters, the high power r.f. amplifiers. It is divided into two sections, the first describes a variety of systems using the circuits, the second gives circuit details and comments on some potential causes of trouble. A printed circuit layout of one system is illustrated as an example.

RECEIVER SYSTEMS

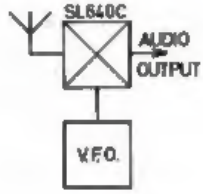
The Synchrodyne

The simplest receiver that can be built from SL600 devices is shown in Fig. 1a. It is not the most common, being a synchrodyne, or direct conversion, receiver. Such receivers may be used for the reception of a.m., s.s.b. and c.w. The v.f.o. is tuned to the carrier frequency in the case of a.m. and s.s.b., and to a few hundred Hertz away in the case of c.w., this results in the demodulation of the a.m. and s.s.b. and an audible beat with the c.w.

Upper and lower sidebands are equally well detected by this receiver and, if the audio passband is limited, it is very selective. If, however, it is used to receive, say, an upper sideband s.s.b. signal with a carrier frequency f kHz., then another such signal with carrier frequency of (f — 2 or 3) kHz. will, if present, be detected, though not intelligibly, and cause interference. Such interference may be removed, and one sideband only detected, by use of the phasing system in Fig. 1c.

The system in Fig. 1a is, of course, only a detector and as such is not very sensitive and has no a.g.c. A more complete system, illustrated in Fig. 1b, has r.f. filters to minimise cross modulation, an r.f. amplifier (or r.f. amplifiers), a.g.c. and perhaps an S meter. Depending on the sensitivity required and the a.f. gain available, one or two r.f. amplifiers can be used.

The SL610 has gain of 20 dB. and frequency response of at least up to 146 MHz. (N.B.—This performance, which exceeds that of the data sheet, depends on very careful layout, very short leads, and very great attention to coupling and decoupling of supplies and a.g.c.; however, Amateurs who use these devices on the two metre band—144–146 MHz.—find their performance at these frequencies satisfactory.)



BASIC DIRECT CONVERSION RECEIVER – FIG. 1a

The figures for the SL611 and SL612 are 26 dB. and 80 MHz., and 34 dB. and 15 MHz. respectively.

Which amplifier is used, here as in all the other systems to be described, depends on the frequency and gain required. The SL612 has the extra advantage of a lower current consumption and slightly lower noise figure.

Fig. 1(c) shows a more complex direct conversion receiver which employs r.f. and a.f. phasing to cancel one sideband so that it is a truly single sideband receiver. It is necessary to have accurate phasing of the signals and well matched gain in the two audio channels before the summing stage. Upper or lower sideband may be selected by reversing the phasing of the audio (or the r.f., but audio is easier). The system illustrated detects l.s.b. when the upper channel phase shift is positive.

The Conventional Superhet.

A much more conventional superhet. receiver is shown in Fig. 2(a). It consists of an r.f. stage with a.g.c. (which would probably be an SL610), an SL640 (or 641) mixer, an i.f. filter which could be LC, crystal or ceramic, an i.f. amplifier with a.g.c., and a detector. The i.f. amplifier could be one or two stage, depending on the sensitivity required, but would normally have a.g.c. applied to one stage only. For the s.s.b. and c.w. detector an SL640 (or 641) with a beat frequency oscillator would be suitable followed by an SL621 to provide audio a.g.c.; for a.m. an SL623 is used which also generates carrier a.g.c. and, with a b.f.o., detects c.w. or s.s.b. An SL432 or an SAA570 will detect f.m., but a separate carrier detector is required to provide a.g.c.

A more complete superhet., with front end and both a.m. and s.s.b. detection, is shown in Fig. 2(b). The audio stage's input is switched between the outputs of the two detectors of the SL623. The a.g.c. line, which also drives an S meter, is switched between the c.w. a.g.c. output of the SL623 and the audio derived a.g.c. of an SL621 connected to the s.s.b. output of the SL623. The i.f. filter may also be switched, a narrow bandwidth one being used for s.s.b., a wider one for a.m. To detect n.b.f.m. a detector such as the SL432 or the SAA570 is connected to the output of the second SL612C. During n.b. f.m. reception a.g.c. should be taken from the SL623.

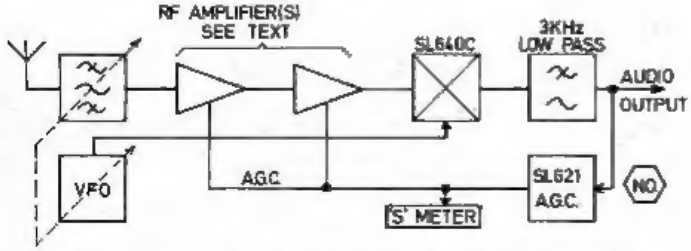
Double Superhets.

Double superhets. may also be designed using SL600 devices but with modern filters double superhets. are rarely needed except at u.h.f. or where complex tuning systems are used. Inasmuch as the same techniques are used as in single superhets., no such systems will be described, but it should be noticed that SL600 devices have high gains, and too many amplifying stages should be avoided.

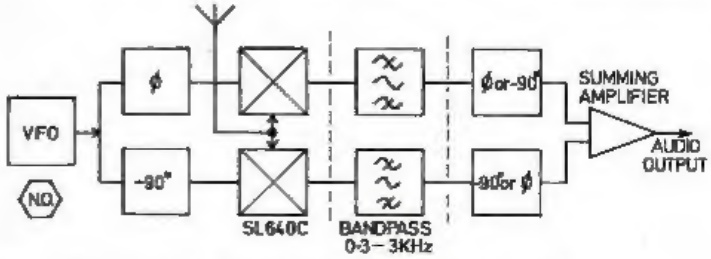
TRANSMITTER SYSTEMS

Filter Type S.S.B. Exciters

There are two types of s.s.b. generators commonly used: filter systems and phasing systems. A basic filter system



PRACTICAL DIRECT CONVERSION RECEIVER – FIG. 1b



S.S.B. DIRECT CONVERSION RECEIVER – FIG. 1c

* Linear Applications Engineer, Plessey Co. Ltd., Cheney Manor, Swindon, Wilts., U.K.

is shown in Fig. 3(a). The audio and a low radio frequency from an oscillator (the b.f.o. if the system is part of a transceiver) are mixed in an SL640 which, as a result of its good carrier rejection, gives as output a clean d.s.b. suppressed carrier signal. This is passed through a narrow bandpass filter to remove one sideband, in this case the lower. The s.s.b. (in this case u.s.b.) remaining is converted to the final frequency by another SL640 and the image is removed by a filter. The output goes to the transmitter linear amplifier.

Fig. 3(b) shows a more complete filter system. It has an internal amplifier which is controlled by an a.l.c. (automatic level control) signal which, in most cases, will be derived from the final linear amplifier—either by a threshold detection system or by grid current detection in the output valve.

R.F. Clipping

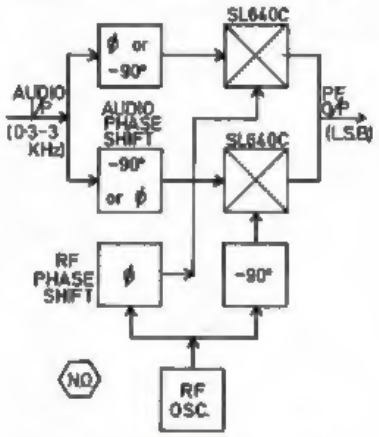
The envelope of an s.s.b. signal does not resemble the audio producing it. Therefore audio limiting and clipping are not useful techniques for increasing the average to peak power ratio of an s.s.b. transmitter, although audio a.g.c. (derived, perhaps, from an SL622 vogad circuit) is. If clipping is carried out it must be performed on the sideband signal itself in the transmitter and, furthermore, the sideband must be filtered afterwards to remove splatter. Such a system needs careful initial adjustment but yields remarkably good results. One is illustrated in Fig. 3(c).

The input audio, which should be controlled by a.g.c., is converted to s.s.b. as in the basic system and is then clipped by a symmetrical peak clipper. The signal is then re-filtered to remove splatter at 2f, 3f, etc., and passes through an a.l.c. amplifier and conversion to the final transmitter frequency. The level of the audio input or the clipping level must be adjusted so that the received audio is of adequate quality—i.e. clipping must not be excessive (but see below for a fully clipped system).

If the clipper is replaced by a Schmitt trigger and the audio input given 12 dB./octave pre-emphasis above 1 kHz., the output may be fed to a class C rather than a linear amplifier and the signal received as s.s.b. though with slight distortion. This gives a peak power equal to mean power during speech and, if carrier leak is allowed to occur during pauses, so that the transmitter is always delivering the same power to the antenna, t.v.i. is much reduced. In this case a.l.c.—and hence the SL610C—is not needed.

S.S.B. Phasing Exciters

A phasing system is shown in Fig. 4. Audio, which must normally be of limited bandwidth, is phase shifted so that two audio lines of equal amplitude but 90° phase shift are obtained. These audio signals are applied to the signal inputs of two SL640s and r.f. reference and quadrature signals are applied to the carrier inputs. The two outputs are summed. If audio reference and carrier reference are applied to one modulator and audio and carrier quad to the other the l.s.b. outputs will be in phase and will add and the u.s.b. will be out of phase and will cancel—thus l.s.b. is obtained. Similarly if audio reference and carrier quad are applied to one and audio quad and carrier reference to the other, u.s.b. is obtained.



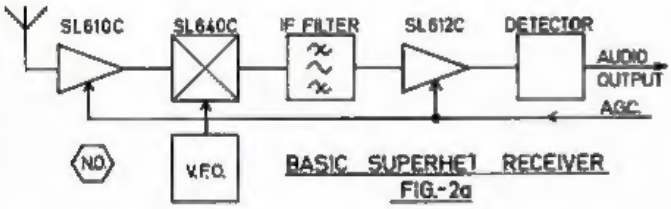
PHASING EXCITER FOR SSB
FIG. 4

This method appears attractive in many respects and has the advantages that no expensive filters are used and that the carrier frequency may be varied so that further conversion may not be necessary. It is compatible with the direct conversion s.s.b. receiver illustrated in Fig. 1(c) and a very simple transceiver can be built using the two systems. The drawback is that to keep the second sideband 40 dB. below the desired sideband the phasing, both audio and r.f., must be very accurate—in fact within 2°. Also, the amplitude of the carrier applied to one modulator must be adjusted to minimise second sideband generation. Carrier leak must be minimised on both the modulators.

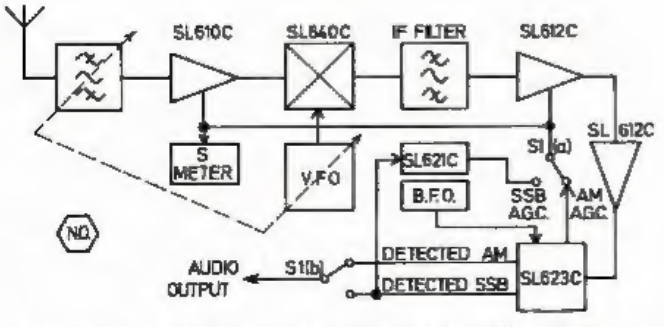
Despite the adjustment problems, this method of s.s.b. generation is very popular—probably because of the saving of expensive filters.

Amplitude Modulation

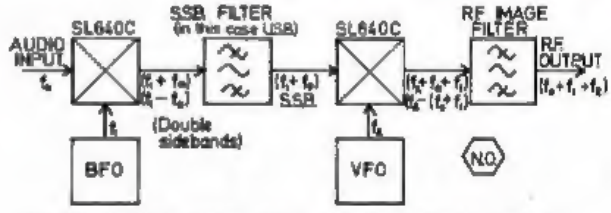
Since a.m. is merely d.s.b. with carrier an SL640 may be used as an amplitude modulator if its carrier leak is increased. If a 15K resistor is connected between pin 2 of an SL640 and earth (as in Fig. 5) there will be sufficient carrier leak for the output of the SL640 to be a.m. By switching in and out the resistor a.m. or d.s.b. may



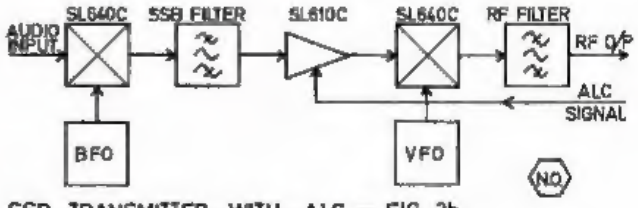
BASIC SUPERHET RECEIVER
FIG.-2a



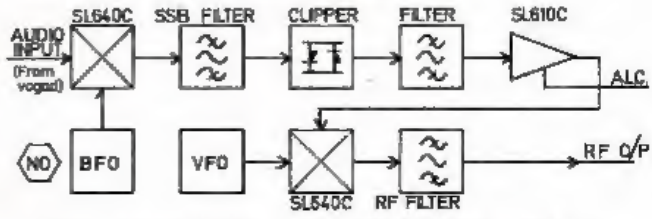
COMPLETE AM SSB SUPERHET RECEIVER – FIG. 2b



BASIC FILTER TYPE SSB TRANSMITTER – FIG. 3a

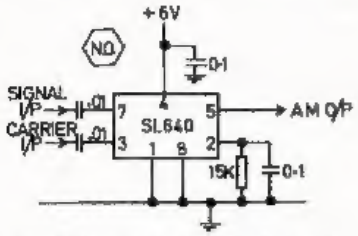


SSB TRANSMITTER WITH A.L.C. – FIG 3b.



SSB TRANSMITTER WITH RF CLIPPING – FIG. 3c

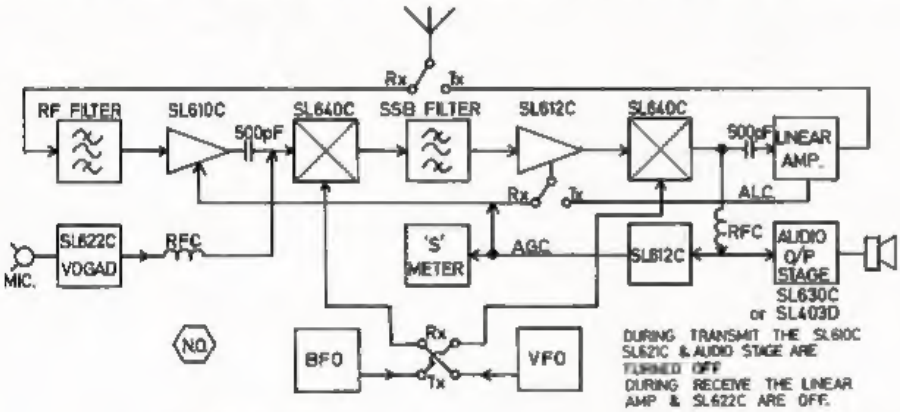
be produced—if the filters following the SL640 are also switched a.m., d.s.b. or s.s.b. may be obtained from the same SL640 with the same inputs. This enables a multi-mode transmitter to be made with very few components.



AMPLITUDE MODULATOR – FIG. 5

TRANSCEIVER SYSTEMS

As is evident if Fig. 2(b) and Fig. 3(b) or Fig. 1(c) and Fig. 4 are studied together, s.s.b. transmitters and s.s.b. receivers of the same type are very similar. Therefore, by a little signal switching, it is possible to make one set of SL600 devices perform both as a transmitter and as a receiver—i.e. as a transceiver. This, of course, saves both on SL600 integrated circuits—which in any case are quite cheap—and on filters which are not. Fig. 6 shows the block diagram of an s.s.b. transceiver. Similarly a phasing transceiver uses far less parts than a phasing transmitter plus a phasing receiver.



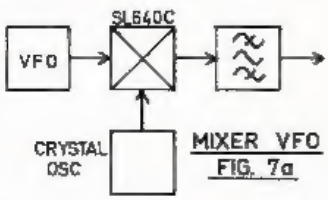
SSB TRANCEIVER – FIG. 6

OTHER SYSTEMS

SL600 devices may also be used in various other parts of transceivers. Some examples are shown in Fig. 7.

Mixer V.F.O.

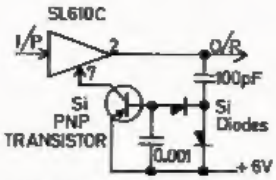
Fig. 7(a) shows a mixer v.f.o. which mixes the output of an l.f. v.f.o. with a crystal derived frequency to produce a stable h.f. v.f.o. In a multiband receiver several crystals may be used to tune several bands with one v.f.o.



MIXER VFO
FIG. 7a

Carrier A.L.C.

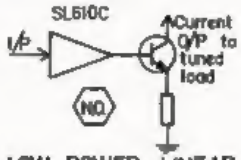
Fig. 7(b) is an a.g.c. system designed to stabilise the amplitude of an r.f. carrier.



CARRIER AGC SYSTEM
FIG. 7b

Linear Amplifier

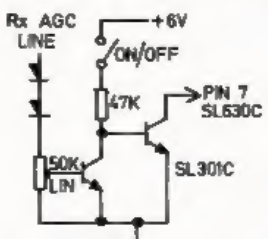
A low power, but simple, linear amplifier is shown in Fig. 7(c). The emitter resistor depends on the transistor used.



LOW POWER LINEAR AMPLIFIER FIG. 7c

Squelch

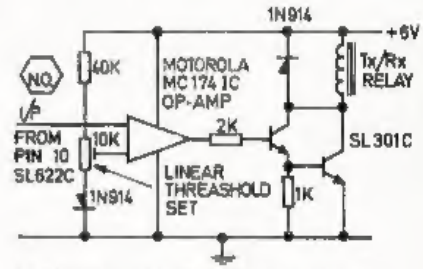
If audio squelch is required in a receiver the system in Fig. 7(d) will provide it. If pin 7 of an SL630 audio amplifier is earthed the circuit is muted—the circuit illustrated, when on, ensures that the SL630 is muted until the a.g.c. reaches a preset level. This prevents unwanted receiver noise when no station is being received. The a.g.c. may be derived from an SL621, and SL623 or other sources. Any high beta silicon NPN transistors are suitable—an SL301 monolithic dual transistor is illustrated.



AUDIO SQUELCH SYSTEM – FIG. 7d

Vox

Similarly a vox (voiced operated transmitter) system may be added to a transceiver using the SL622 as its microphone amplifier. A possible circuit is shown in Fig. 7(e), it consists of an op.-amp. which is switched by the a.g.c. voltage of the SL622 and in turn switches the transmit/receive relay of the transceiver. The transistor can be any high gain silicon type which can carry the relay current—a Darlington arrangement must be used to ensure that the relay turns off again as the minimum output of the op.-amp. can sometimes be greater than 0.7v. above the negative line.



VOX FOR USE WITH SL622C
FIG. 7e

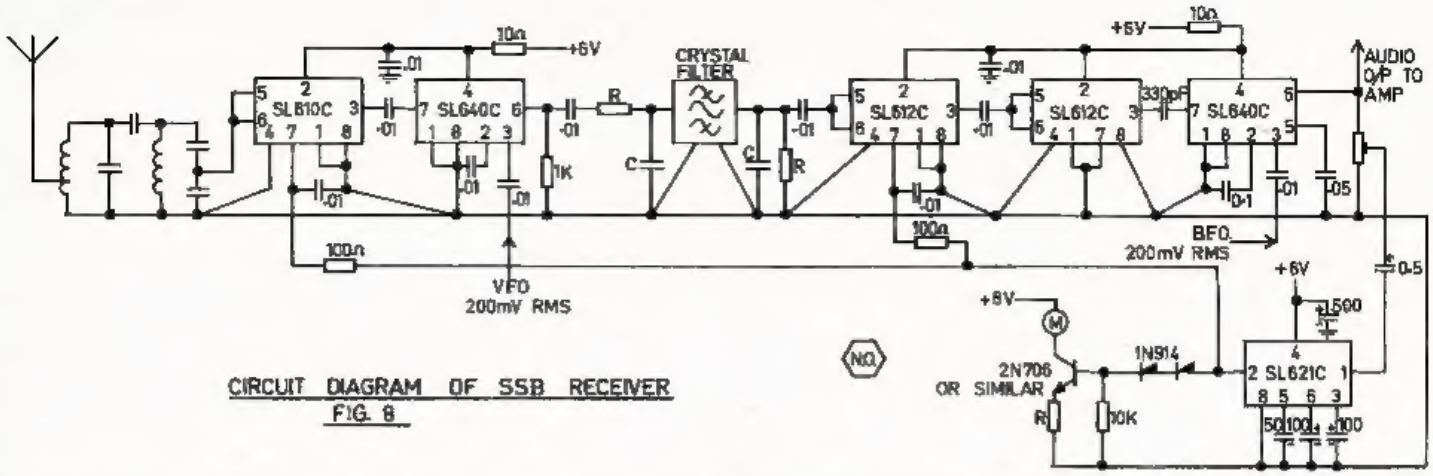
USING THE CIRCUITS

Fig. 8 is the circuit diagram of the receiver in Fig. 2(b). The simplest way of explaining the use of the SL600 family is to describe the circuit and its operation in detail.

The input filter depends on the band being tuned and the i.f.—it must be sufficiently narrow to give rejection at the image frequency—i.e. that frequency on the other side of the local oscillator from the wanted frequency and spaced the same amount from it. If such a frequency passes the input and mixes with the local oscillator it will produce an unwanted output at i.f. The method of coupling is chosen so that the SL610 input is never inductively terminated and also so that the tuned circuit is not loaded enough to reduce its Q. If an SL610 input looks inductive, instability is possible. When an SL610 is driven from a source which might be inductive the source should either be shunted with a few kilo-ohms or a few hundred ohms should be connected in series with the input.

The SL610 is biased (as are all the other r.f. and i.f. amplifiers in this receiver) by connecting its bias pin directly to its input pin. If coupling is made to an SL610, 11 or 12 as in Fig. 9(a), slightly lower noise will result but this is not usually worth the extra complication. It is important that the input and output earths of these devices are kept separate—output currents flowing in input earth leads tend to produce instability.

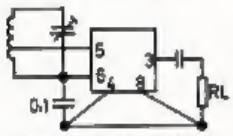
Both the a.g.c. line and the SL610 positive supply (which is shared with the SL640 mixer) are decoupled to earth. Ideally, this is not necessary but r.f. on h.t. and a.g.c. lines can cause trouble with some layouts (the SL640 supply is not internally decoupled



CIRCUIT DIAGRAM OF SSB RECEIVER

FIG. 8

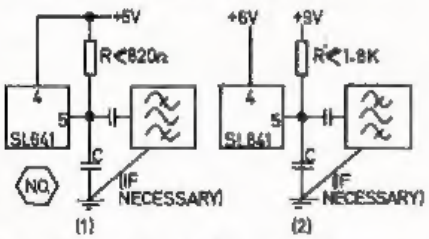
although the SL610 is) and where expense does not rule it out it is recommended. To minimise the output current loop of the SL610 the earth of the SL640 should be as near to the output earth (pin 8) of the SL610 as possible.



LOW NOISE COUPLING TO SL610, 11, 12.

FIG. 9a

The SL640 acts as the first mixer and its output drives the input of the filter. The filter must be terminated by the correct impedance (pure resistance or resistance shunted by capacity) and if the resistive component is low enough the SL641 may be used on one of the circuits in Fig. 9(b). This is the case wherever SL640s are used: they may be replaced by SL641s in certain circumstances. When output pin 6 of the SL640 is used an external load of >560Ω is required. This output is an emitter-follower of low Z_{OUT} and must not be used to drive capacitive loads. Some filters have wound inputs with low (<10Ω) d.c. resistance to earth. In this case the terminating resistor, as long as it is over 560Ω, may also act as the load resistor, the d.c. blocking capacitor must **not** be used.



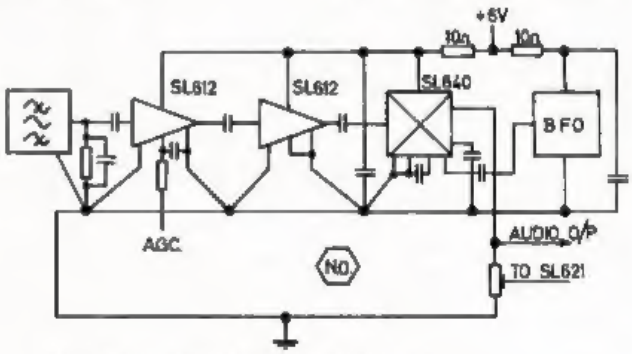
MATCHING SL641 TO FILTERS

FIG. 9b

Pin 2 of SL640s or SL641s must be decoupled to earth by a low-leakage (<100 nA.) capacitor having low reactance (<10Ω) at the lowest input or carrier frequency. Carrier input from the local oscillator should be as free from modulation as possible and between 100 and 200 mV. r.m.s. in amplitude.

The broadband i.f. amplifier following the filter consists of two SL612s, a.g.c. is applied to one only. An SL610 has 50 dB. a.g.c. range and an SL612 70 dB., giving a total for two gain controlled stages of 120 dB.—if both SL612s were controlled this would be 190 dB., too much.

The positive supply to the i.f. stages and the SL640 detector is decoupled and care must be taken that earth current from the output of the strip cannot flow near its input as this leads to instability. The best earth arrangement for the i.f. strip is given in Fig. 9(c). No other connections should be made to the i.f. strip earth.



I.F. STRIP EARTH LAYOUT - FIG. 9c

The filter must be correctly terminated at its output. The input of an SL612 is approximately 5K and 4 pF., if necessary this should be shunted (at a.c. only) by other resistors and capacitors to make the correct terminating impedance.

When a.g.c. is applied to an SL612 its d.c. output potential moves. This i.f. signal, if fed to the detector, will produce a change in output which, in turn, can produce a.g.c. from the SL621 and thus v.l.f. instability or motor-boating. To prevent this, the coupling capacitor between the last SL612 and the SL640 should be as small as possible—about 330 pF. is usual if the i.f. is over 1 MHz. Alternatively, a tuned circuit at this point prevents the trouble and also reduces noise produced in the broadband stages.

The output of the SL640 detector is decoupled to ground at frequencies above 4 kHz. by a 0.05 μF. capacitor on pin 5, and the load on pin 6 is a 1K preset pot. The audio output to the amplifier is taken directly from pin 6, but the audio for the SL621 a.g.c. stage is taken from the potentiometer wiper. This enables the a.g.c. threshold to be adjusted so that noise in the set and aerial does not turn on the a.g.c. in the absence of signal. The coupling capacitor to the SL621 should not exceed 1 μF., otherwise l.f. instability can result.

The SL621 will usually drive a 500 μA. S meter connected (in series with 5.1K and three silicon diodes) from the a.g.c. rail to earth, but as such a load is sometimes too much for an SL621 the transistor circuit shown is preferable. The value of the emitter resistor depends on the meter used and is given by the formula:

$$R = 2.7 \div I$$

where I is the meter f.s.d. current in mA. and R is in kilohms. The S meter reads linearly in dB—from zero to full scale is about 120 dB.

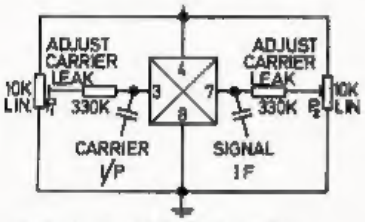
The supply to the SL621 must be well decoupled at l.f.—500 μF. is usually sufficient, but if the audio output stage shares the same power supply this should be increased. If a series/stabilised supply is used it should have a source impedance of less than 1 ohm.

The audio output stage may be an SL630, an SL402, an SL403 or any other suitable amplifier. If the SL630 is used its supply should be decoupled at r.f. and the frequency response limited as detailed in the SL630 application note.

When the SL600 circuits are used in a transmitter or transceiver they are used much as above. One or two additional points may be noted.

As transmitters often contain large r.f. fields, particular attention must be paid to screening and decoupling. It may in some cases be necessary to decouple individual stages.

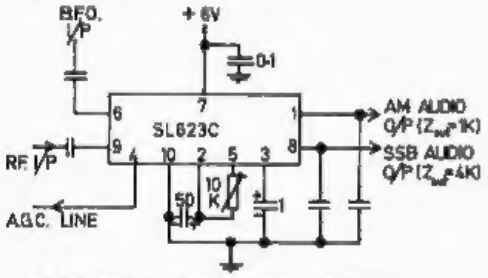
When generating s.s.b. or mixing frequencies in a transmitter the original input frequencies are not wanted in the output. The SL640 and 641 have some 30 dB. signal and carrier rejection but this may be increased with the circuit in Fig. 9(d). With signal but no carrier P1 is adjusted for minimum signal leak, and with carrier but no signal P2 is adjusted for minimum carrier leak. All modulators used in transmitters may be adjusted in this way although it is less important in filter systems than in phasing systems.



SIGNAL & CARRIER LEAK ADJUSTMENT – FIG. 9d

The a.g.c. characteristics of the SL610, 611 and 612 are temperature dependent. It is unwise to use a voltage on an a.g.c. pin to set the gain of a stage (although it may be done where a.g.c. is applied to another stage in the chain to compensate for variations).

SL610s, 611s and 612s tend to oscillate if required to drive capacitive loads. Such loads should be buffered either by a resistance (SL610, 611: 47 ohms; SL612: 150 ohms) or another type of amplifier. When r.f. is taken from these SL600 amplifiers to points far removed from them care is essential to prevent instability caused by earth loop currents.



SUGGESTED CIRCUIT FOR SL623C FIG. 10

USING THE SL623

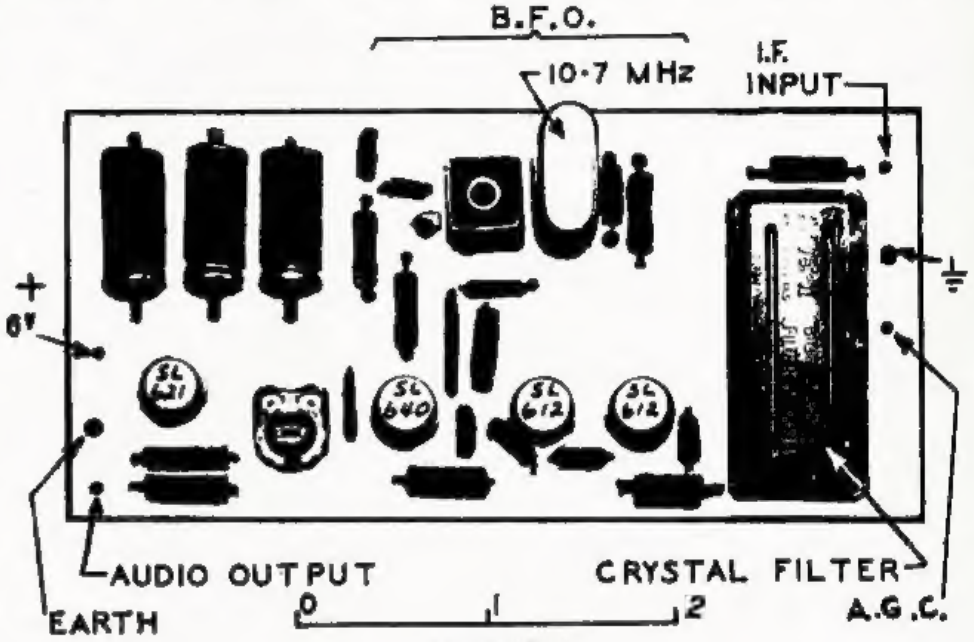
Special mention must be made of the SL623 as it is not used in s.s.b. receivers but only on a.m./s.s.b. hybrid receivers. A typical application of the SL623 is shown in Fig. 10. The a.g.c. from this circuit is c.w. derived and if audio a.g.c. is required during s.s.b. reception an SL621 should be used.

All the decoupling capacitors should go to one point and the positive supply should be decoupled. The circuit is as sensitive to s.s.b. as an SL640 but requires 125 mV. r.m.s. of a.m. to activate the a.g.c.—thus greater i.f. gain may be necessary. Despite statements to the contrary in the provisional data sheet, this circuit functions to at least 30 MHz. and, with reduced performance, to over 120 MHz.

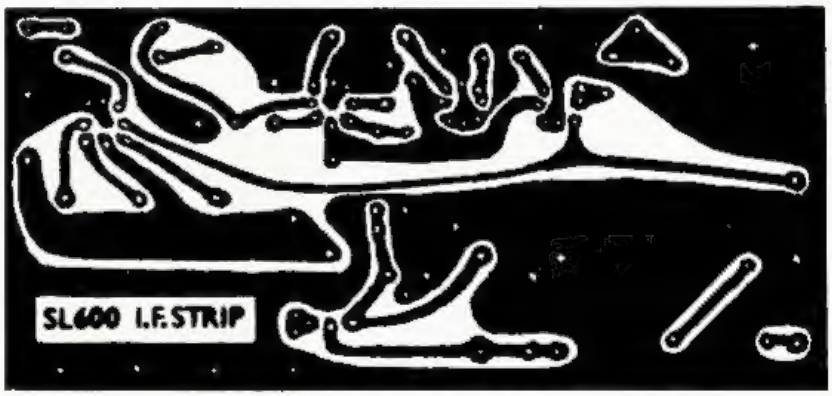
The resistor between pins 2 and 5 sets the value of carrier at which a.g.c. commences.

The b.f.o. should have a clean sine wave at about 100 mV. r.m.s.

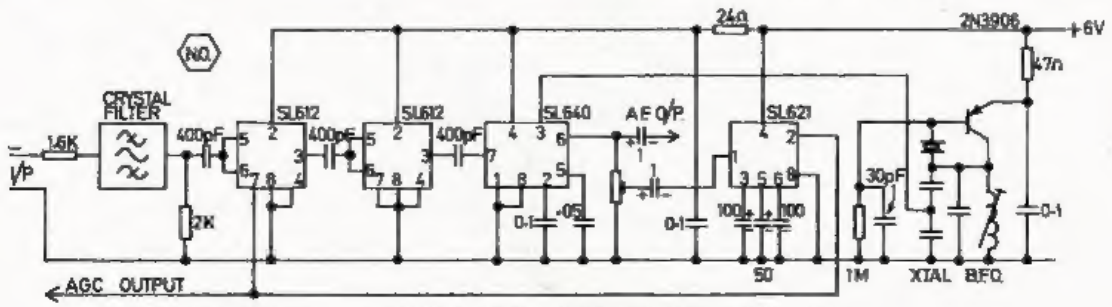
(Continued on Page 9)



Circuit Layout of Fig. 11a.



Printed Circuit Board for Fig. 11a.



CIRCUIT OF 10·7 MHz. IF STRIP SSB DETECTOR AND VOICE AGC. ILLUSTRATED IN PHOTOGRAPHS – FIG. 11a

LONG PATH GREAT CIRCLE MAP

L. H. VALE, VK5NO/1*

● The primary use of Great Circle or Azimuthal Projection Maps by Amateurs is to give instant indication of bearing for beam directing, interpreting ionospheric predictions, etc. They also indicate distance from the point of origin to any chosen point on the earth's surface.

These functions are limited to the short path or most direct route, whereas, in practice, quite a high proportion of DX contacts are made over long path circuits, i.e. the signals travel more than half way around the earth to arrive at their destination.

While it is easily possible to determine the direction of a long path signal by considering it to be 180° from the short path direction to the chosen point, and to calculate the distance by subtracting the short path distance from the earth's circumference, we decided that it should be worthwhile to make a map that includes long path routes of up to about 270° of the earth's surface rather than be limited to the maximum of 180° available in a normal great circle map. In addition to making directions and distance instantly apparent at a glance, it was felt that such a map would give the user a better feel for the world as it is under long path propagation conditions.

Fortunately the construction of such a map is very easy and straight forward, if a little tedious, if it is constructed as an addition to a normal great circle map. The method described assumes that the earth is spherical and that signals travel in a straight line; these are reasonable and generally accepted assumptions.

Firstly, obtain a normal (short path) great circle map centred on your locality; the long path map given as an illustration is centred on the Adelaide area and would become rather inaccurate if used more than a few hundred miles from Adelaide. The diameter of the long path map will be about 50% greater than this short path map so it is necessary to start with a comparatively small short path map or be prepared to finish up with a monster.

Paste the map to the centre of a piece of white card of sufficient size.

Obtain a rule or straight edge at least as long as the diameter of the short path map and make two marks on it separated by this diameter.

The extensions to the 180° map are now drawn by placing one mark on a chosen point on the 180° map, running the rule through the point of origin (the centre point) and marking the point where the second rule mark comes to on the card outside the 180° map.

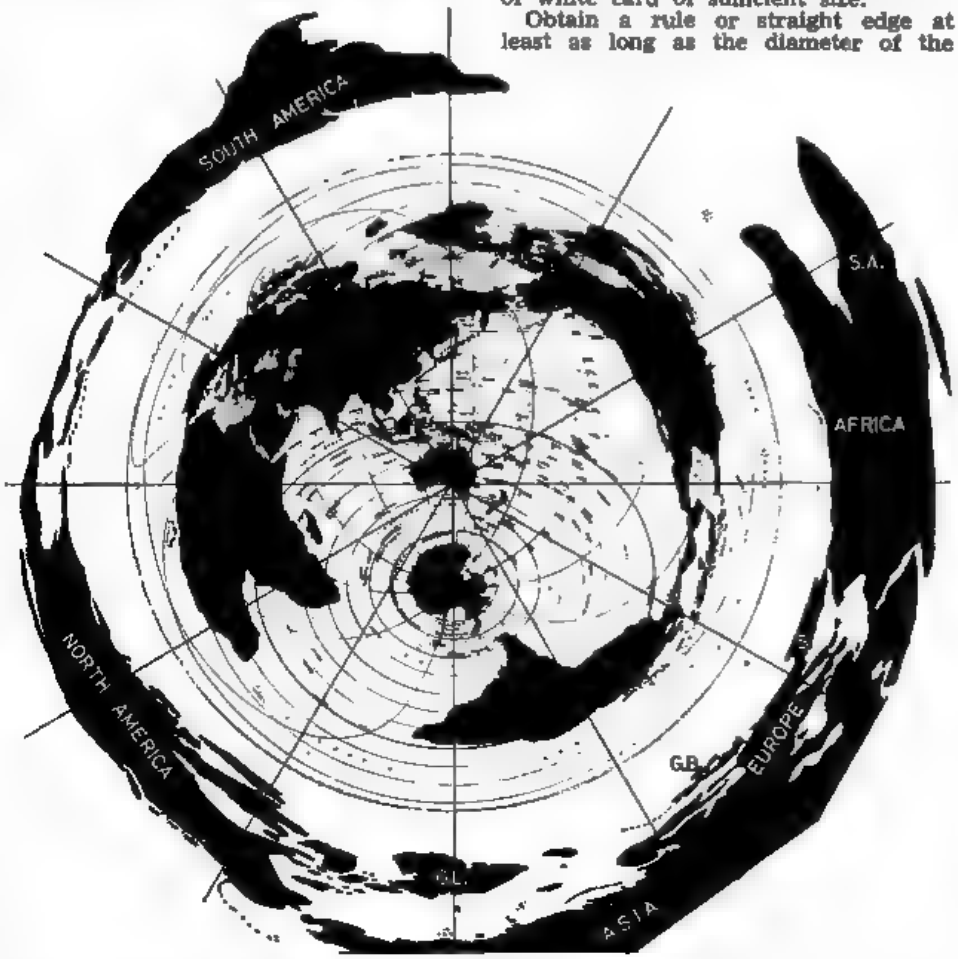
It will be seen that each continent, except Asia, repeats itself outside the circumference of the 180° map.

Tracing around the coastlines of the continents is tedious and you may well agree with us that the outlines of the continents are sufficient, but it would probably be of some advantage, in view of the distorted shape of the land masses, to include national boundaries and the meridan grid as an aid to finding rarer countries or places more quickly.

Asia has to be cut through the middle; actually the map as drawn includes all areas workable on the long path and the distortion increases as does the distance from the centre point.

The map illustrated was constructed by the writer as a personal exercise and is about fifteen inches in diameter. It is used in conjunction with a Mercator's projection map and a short path great circle map, all of which are pinned on the wall. These maps enable an operator, if he is so inclined, to more easily "feel himself into" this globe as it appears on high frequency radio. The exercise has been well worthwhile, but is certainly not everyone's cup of tea. ●

* C/o. Box 309, Fyshwick, A.C.T., 2609.



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SL600 SERIES ICs

(Continued from Page 8)

OTHER DEVICES

The other members of the SL600 family are the SL620, 622 and 630. The SL630 is an audio amplifier with voltage controlled gain and up to 75 mW. (at 6v.) or 200 mW. (at 12v.) output. Used with the SL620, which is similar to the SL621, it forms an audio a.g.c. system. The SL622 is a self contained audio a.g.c. system with an additional sidetone output which is not a.g.c. controlled.

These circuits are intended to be compatible with the rest of the SL600 series, use the same power supplies and are, like them, in TO5 packages.

This article has described how the Plessey SL600 series circuits can be used in h.f. transmitters, receivers and transceivers. It can be seen that, with the exception of oscillators and power amplifiers, h.f. transceivers can be built using SL600 devices for all functions. V.h.f. and u.h.f. sets can be built with SL600 devices in all but the r.f. and mixer stages. These devices make the design of a.m. and s.s.b. transceivers extremely simple and their setting up trivial. ●

BUILDING MODERN FILTERS

PART ONE

*By "CABBAGE-TREE NED"**

● Many of us have been aware that new methods of filter design have evolved over the last 20 or 30 years, but understanding them has appeared to require more mathematics than most of us can use. This may be true, but VK3ZRQ shows us in this whimsical series of articles that little more than simple arithmetic is necessary to apply some of the new methods to practical filter construction.

INTRODUCTION

Cabbage-tree Ned, so Dal Stivens tells us, was the crack shot of the whole North Coast of New South Wales. He shot so straight he could shoot the eye out of a snail at 100 yards; and he shot so far that he had to salt his bullets so the game would keep until he could catch up with it! But the real feature about Cabbage-Tree was the structure suspended from the brim of his hat—a series of short lengths of string with a cork at the end of each, a Comb Structure as it were. In fact, of course, it was a filter with a stop-band for flies.

Here the facetious analogy with the Comb Filter must cease, because, although the flies represent a periodic series of pulses, what the electronic comb-filter does is **pass** such discrete frequency components and **reject** noise (which usually has a continuous spectrum or band of frequencies).

Now, "modern" or "synthesised" filters need be no more troublesome to calculate and build than the macroscopic device referred to above.

Let's clear the air by collecting thoughts on filters—then you may feel prepared to try out the two audio low-pass filters whose details appear below. Their performance is quite satisfying.

FILTER TYPES

This much very briefly!

Filters can be classified in several ways:

(a) Frequency segment involved—a.f., r.f., or microwave.

(b) Circuit arrangement of elements—e.g. T, Pi, or Lattice.

(c) Character of the elements—LC (lumped element) devices; coaxial (distributed element) filters; resonator filters (such as electromechanical and piezo-electric crystal); and active filters (containing an internal energy converting device such as a transistor).

The first three types are called **passive** filters—that is they contain no transistors or valves.

* VK3ZRQ, A. G. Birch, 5 Harrison Street, Bendigo, Vic., 3550.

FILTER APPLICATIONS

It was nearly 90 years after Faraday formulated the law of electro-magnetic induction (in 1831) that Campbell and Wagner in 1915 realised the use to which frequency sensitivity of inductive reactance could be put. And so was born on absolute fundamentals the first LC filter. Nowadays, these filters have become an indispensable tool of consumer, industrial and amateur electronic systems.

Any Amateur will recognise that some of the following are applications which could force themselves upon his attention:

1. Pre-selector networks, at the input of sensitive receivers, to separate low-amplitude wanted signals from higher amplitude undesirable signals.
2. I.f. filters. Used to provide the basic receiver selectivity.
3. S.s.b. filters, which aim to suppress one sideband, and facilitate synchronism of the carrier frequency.
4. Anti-jam filters, to improve radar-target detectability.
5. Matched filters, for use in identification of radar targets, and in meteor-burst communications.
6. Other radio uses: Broadbanding filters (between transmitter and narrow-band i.f. antenna), coupling networks, harmonic suppression.

DOWN-TO-BUSINESS

To make the best choice of the available tools, we need to know two things:

(a) What we **want** to do;

(b) What each of the various methods **can** do.

Hence the following:

We must necessarily restrict exploration to the terms of item (c) of the third heading under Filter Types—namely character of elements. We choose (because of limitations on what a home-based Amateur can handle) to look at **modern** or **synthesised** LC filters, and briefly at the increasingly feasible **active** filters.

Active filters, by the way, you have played with when you built a Q-Multiplier, or an i.f. amplifier. With the aid of today's IC devices, active filters are one possible answer to the need, in a micro-miniature electronic world, for all circuit elements to be compatible in size. In the filter field, this means devising an inductorless filter and can be met by an electronic **equivalent** inductance provided the circuit used can be given satisfactory Q-factor and stability. Your reactance-modulator, for example, uses equivalent electronic inductance.

PASSIVE L-C FILTERS

These are constructed according to two different concepts:—

(a) Elementary sections of the constant-K type. These are based on image impedance notions, and are improved as to performance by cascading blocks (like stages of amplification) with the aid of an ingenious little fellow called M, to obtain a desired response.

(b) **Synthesised** or **modern** filters are not a combination of sections in the above sense. They are calculated as a whole, from mathematical equations whose graphs have been seen to have just the shape of filter response that we often need.

Both of these concepts use the traditional elements L and C, because their frequency-sensitivity will do what we need—offer a high impedance to (or **reject**) certain frequencies according to value and circuit arrangement.

Here we simply acknowledge that any filter does two jobs:—

(a) It acts as an energy-transfer device;

(b) It is selective as to frequencies passed.

CREDITS FOR L-C DEVICES

They dissipate negligible power, are stable in themselves, can be made to reasonable tolerances, generate little noise, and provide a d.c. path or total d.c. isolation as required. Finally, there is no offset voltage to worry about.

MODERN (or SYNTHESISED) FILTERS

The whole purpose of this article is to illuminate the virtues of the modern filter. Being designed as a whole, it can provide a better filter than the traditional constant-K type.

The procedure is greatly simplified by tables, step-by-step design procedures, and/or design curves. It is true that the theory behind all this is still one for the specialist, but the results of his work can well be used by the technician or by the Amateur with a taste for a challenge.

Note, by the way, that the term "section" may still appear even when a filter is of the "modern" type, as when a group of physical elements is combined in a schematically separate network, each such group being designed as a whole. Sub-division into such "sections" may be dictated by, say, excess of insertion loss and the need for an in-between amplifier, or, in the case of a crystal filter, the need to eliminate spurious responses.

Two specimen designs which immediately follow are the fruits of "modern filter" concepts as outlined above. They are respectively:

(a) **Maximally-flat**, or **Butterworth** filter. This is used for its simplicity, and its excellence around near-zero frequencies. It has tolerably good amplitude response, and no ripples, but

not a very steep skirt. To a pulse type input, its response does have overshoot.

(b) **Elliptic.** This is an approximation to the ideal filter characteristic (vertical sides). It accepts that, in the interests of steeper skirts, some ripple may be tolerated **within** the pass-band. Further, it has in-built notches of added attenuation (above the wanted stop-band value) which can be useful for rejection of command signals, etc. The size of the ripple can be chosen, commonly less than 1 dB., and to some extent we can choose the notch frequencies as long as we are prepared to accept a slightly less favourable v.s.w.r. (Note: The Butterworth filter is actually a special case of a class in which there is ripple in the pass-band, but no attenuation-notches in the stop-band. This class of filter is known as **Chebyshef**. See Fig. 1.)

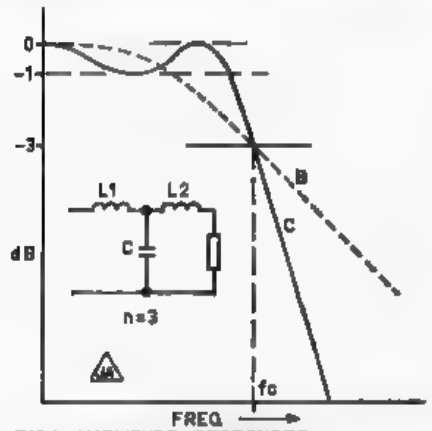


FIG 1 AMPLITUDE RESPONSES
B=BUTTERWORTH C=CHEBYSHEF

TWO SPECIMEN FILTERS

(Note: The relevant design data will be given in Part 2.)

(A) Maximally-Flat (Butterworth) Design (Fig. 2)

Specifications: LP filter to have 3 dB. cut-off at 3.5 kHz., attenuation about 30 dB./Octave, and work into a load of 600 ohms from a voltage-source. The coils should have a Q-factor in the region of 200. The temperature-coefficient to be satisfactory up to 50°C.

Solution:

L1 = 42 mH. (226 turns).
L2 = 37.7 mH. (215 turns).
L3 = 8.42 mH. (102 turns).
C1 = 0.128 μF.
C2 = 0.068 μF.

Pot-Cores: 26/16 cores, of 3H1 material.

Wire: B. & S. 28 gauge Lewcomex single-strand Cu (special enamel, easily removed), chosen to give nearly-filled winding space on the 26/16 plastic bobbins.

Actual Q-factors were not less than 150, which was still acceptable.

Air-gap in the pot-core centre-post: as hand-ground = 0.008 in.

Performance: Very slight hump near roll-off point, and the expected rounding of voltage-response down near the 40 dB. attenuation level at 9.2 kHz.

Application. To be used in part of the Zone translator set-up.

(B) Elliptic Filter (Fig. 3)

Specifications: LP filter to cut-off at 3 kHz., work between source and load both of 600 ohms, provide minimum attenuation in the stop-band of 50 dB. for all frequencies above 4 kHz. Use the minimum number of inductors (which is two) for the obvious choice of possible circuit arrangements of T-input or Pi-input. (See Part 3 for details.)

Solution: Use parallel-resonant series arms, and simple-C shunt-arms.

We obtain:

C1 = 0.0138 μF.—shunt C.
C2 = 0.0015 μF.
C3 = 0.0187 μF.—shunt C.
C4 = 0.00425 μF.
C5 = 0.0117 μF.—shunt C.
L2 = 34.9 mH. paralleled with C2 —series arm.
L4 = 27.9 mH. paralleled with C4 —series arm.

Performance: As shown in Fig. 4.

EXPLANATORY COMMENTS

(a) Inductors were made the hard way, to get the feel and prove a point.

(b) Both are made with 26/16 pot-cores (mass-produced hence cheapest; also suitable for a wide range of L-values). Being audio-filters, no attempt was made to maximise the Q-factor.

(c) The air-gap was ground by hand with a home-made tool, micrometer, and some 600-grit silicon carbide (amateur gemstone shops).

(d) Coils were hand-wound and checked for value on an H-P vector impedance meter. No trimming was needed (before cementing the core-halves) to be within 1% of designed values of L.

(e) The **easier way**, which the writer will follow in future, is to buy pre-gapped P-cores with slug-adjustor capable of ±10% variation of L, for a slightly higher cost (70c against 55c).

ACTIVE FILTERS

One way of achieving an inductorless filter is to use only RC elements, but because they have high insertion loss or pass-band attenuation, no one uses them.

Active filters, on the other hand, can have insertion-**gain**. They lend themselves to modern micro-miniature methods, and make extensive use of the very easily handled operational amplifiers, such as the 741, or 739 (a dual-in-line), the 715 (for unity gain), or the 725 (for cases where gain is positively useful).

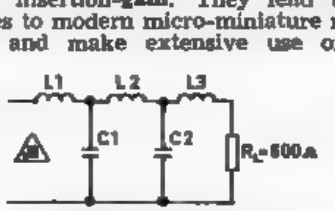


FIG 2 BUTTERWORTH-30dB/OCT, n=5

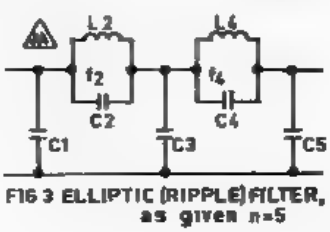


FIG 3 ELLIPTIC (RIPPLE) FILTER, as given n=5

They are most useful at low frequencies (below 1 MHz.) where simple solid state devices can have appreciable gain.

Practical active filter schemes (see Dannecker, et al) are based on applications of IC technology with specialised design techniques

In short, active filters do overcome the limitations of passive RC filters, but are still (at present) susceptible to sensitivity problems, particularly of Q-factor with respect to gain

The answer for the Amateur will probably be only in handling experience and much thought. Applications Notes by various manufacturers should help original effort greatly. Some considerable help will also be gained with the aid of a Table and Chart method of calculating component values published by other authors.

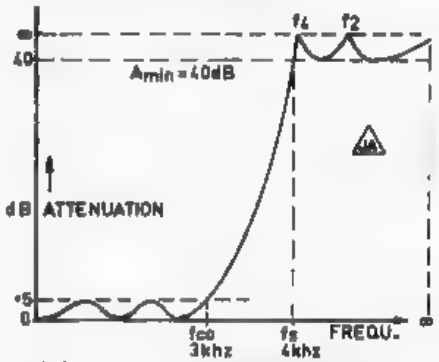


FIG 4 RESPONSE OF FIGURE 3 FILTER

BACKGROUND

The Filter Tables to follow in Parts 2 and 3 can be compiled in several ways, just to satisfy your curiosity.

(a) The Grass-Roots Method

Kirchhoff analysis will give us the ratio of V_{OUT}/V_{IN} in terms of the L and C elements of a given order of filter. Then we look up the corresponding Butterworth (say) Polynomial, and simply compare coefficients to evaluate the L and C.

For a 3rd order Butterworth (voltage-source), the Kirchhoff expression is

$$F(s) = \frac{1}{s^3\frac{L1L2C}{R} + s^2L1C + s\frac{(L1 + L2)}{R} + 1}$$

and the Butterworth expression that corresponds is

$$F(s) = \frac{1}{s^3 + 2s^2 + 2s + 1}$$

In another three lines of simple arithmetic, we find that the L1, L2 and C are respectively 0.238 H., 0.0795 H., and 0.212 F. for R = 1 ohm and f = 1 Hz. (1.5 H., 0.5 H., and 1.33 F when frequency in radians/sec.)

The method becomes tedious (to say the least) for anything above 5th order (5-section) filters.

(Continued on Page 13)

T.V. TUNER SOLID STATE CONVERSION

BY THE TECHNICAL EDITOR

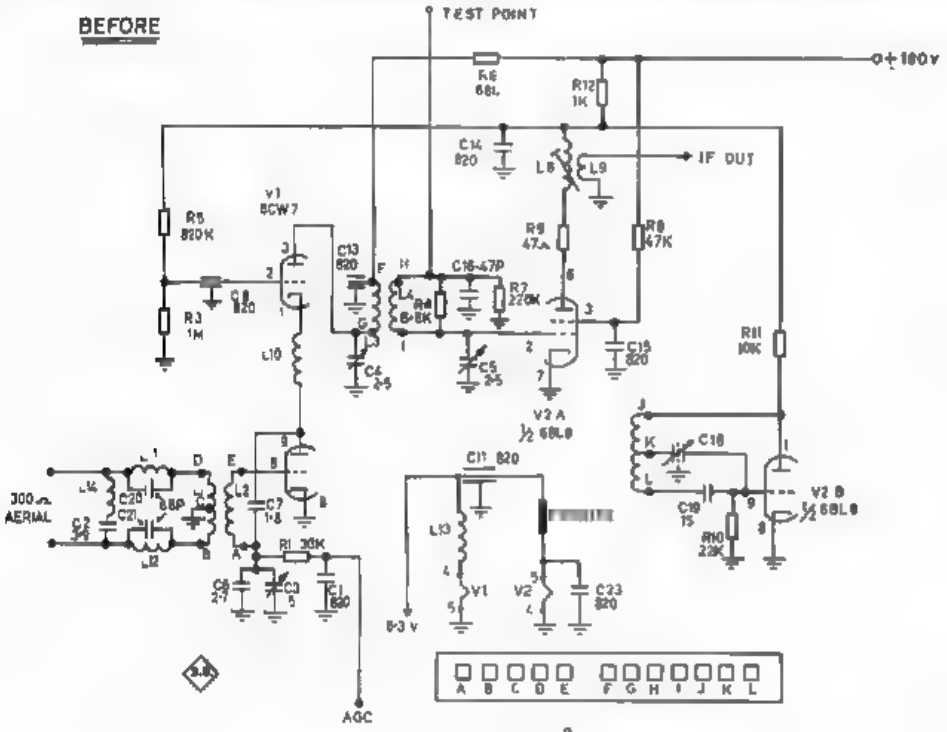
● A letter received recently from Jim Fricke, VK1JF, describes how he has converted a Philips AT7580 valve-type 10-channel t.v. tuner to use transistors instead of valves.

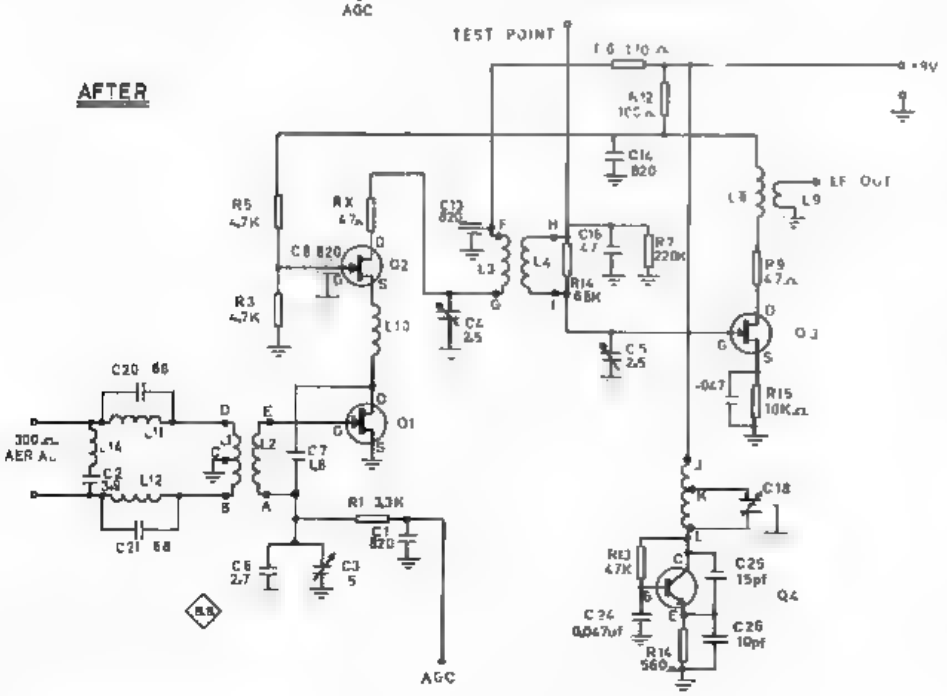
The accompanying circuit diagrams show the tuner before and after modification. The 6CW7 cascode r.f. amplifier was replaced by two 2N5485 FETs (Q1, Q2), the mixer (6BL8 pentode) by another 2N5485 (Q3), and the oscillator (6BL8 triode) by a BF115 bi-polar transistor (Q4). Initially a FET was tried as the oscillator also, but in Jim's words, "After eight hours of experimenting the results were still disappointing."

Some additional components were necessary, particularly for the oscillator, but the fact that only four of the original resistors (R3, R5, R6 and R12) needed to be changed shows rather clearly the similarity in characteristics between FETs and valves (except for their radically different power requirements!).

Although 9 volt supply is shown, Jim claims the tuner operated quite well with only 6 volts. The lower channel (1, 2 and 3) oscillator coils may need a few extra turns, and the old channel 1 coils will in any case need extra turns on all windings if required to cover channel 0. The 47 ohm resistor Rx in the r.f. drain circuit was found necessary to prevent oscillation in Q2. The transistors were all mounted above the valve sockets and soldered to the appropriate contacts. R13, R14, C24, C25 and C26 were also mounted on top of the tuner.

A possible application, not suggested in the original letter, could be to use the tuner as a multi-band v.h.f. converter with extended oscillator tuning range if necessary by fitment of an added variable capacitor to the fine tuning. Frequency stability may not be impressive, but if a suitable i.f. channel in the 31-36 MHz. range could be provided, the 6 and 2 metre bands could be covered readily on the existing channel 1 and channel 5 coils respectively. ●





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MODERN FILTERS

(Continued from Page 12)

(b) **The Elegant Method**

The equation quoted by R. Dannecker for the low-pass filter in his Phase-Lock Loop articles ("A.R.," Feb. 1972) is a staging-point in pole-zero methods, a particularly useful sort of compactness. For the engineer does not, on the whole, indulge in pole-zero patterns for the sake of it. He believes in the conservation of energy, and the simplest solution of a problem.

The familiar gain/frequency and phase/frequency curves of an amplifier or filter give more detail than we often need. Certain critical frequencies called break points (and a constant multiplier) are all that is necessary.

Break points are points where the skirts of a filter response change slope suddenly, and in mathematical language are related to points known as poles and zeros. They give rise to a plot called a pole-zero pattern which is the graphical heart of S-plane design, only the results of which you will be using via the Tables of Parts 2 and 3.

(Continued on Page 15)

MORE ON MORSE KEYS

ONE MORE DROP OF HOME-BREW

T. LAIDLER, VK5TL*

About 35 years ago and under slightly different circumstances, I made the key I still use.

Lacking access to the facilities available to VK3AXU, the method adopted was different, in that I made some wooden patterns, arranged for the castings to be made in the city (500 odd road miles away) and spent some time with a file on the castings made. The cost (in those days) was not considered excessive at eight shillings for two sets. A set of ignition contacts cost about 7/6 (75 cents).

A local garage was able to supply what was termed a "standard taper" pin and made the necessary tapered hole through the bar and uprights of the "U" section for a small charge. The pin is held in by a screw through the appropriate place in the key bar. (This pin tapers from 1/4" to 3/16" over a length of 2".)

The front contacts are located 1-5/8" from the front end of the key bar and the rest of the fittings are much as outlined by VK3AXU, except that screws are fitted into the right hand sides of the centre and front sections to permit wiring on the sides. This is just convenience in manufacture.

* 18 Albion Avenue, Glandore, S.A., 5037.

For anyone with a slight knowledge of woodwork, patterns can be made in a manner to those outlined below; wood being easier to work than metal. Mine were given a good coat of shellac before sending to the foundry, this was recommended by a patternmaker. (Patternmakers are highly skilled woodworkers.)

If the key bar and "U" sections are cast, the other pieces for front and back blocks can be cut from the appropriate sized metal, but I had mine cast and thus gave myself more file work.

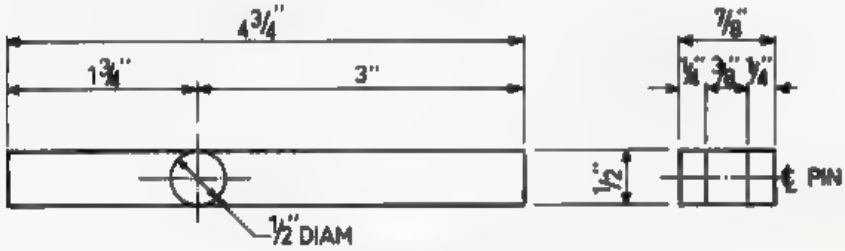
The regular Morse key was usually fitted with platinum in the contacts, but we poorer mortals, without access to platinum, seem to get by with automobile contacts which are probably tungsten. Bearing this in mind, give them occasional cleaning and, while on the job, take the pin out and put a smear of oil on the moving parts of the pin—it helps.

When setting up spring tension, do not make it any heavier than necessary to return the key bar to normal position. This eases wrist pressure to overcome the spring when pressing down.

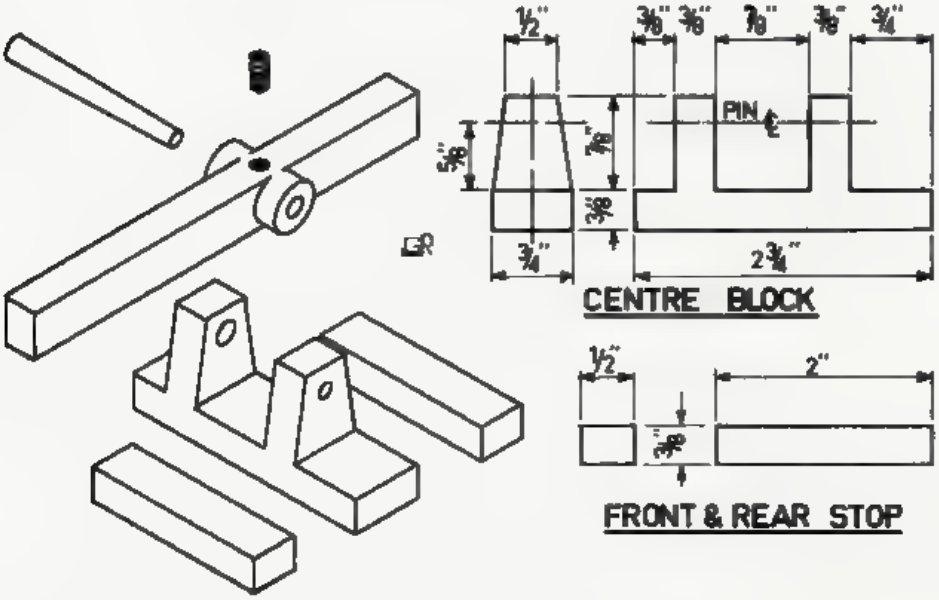
For ease of operation, I pass on what was part of my Morse instruction in days gone by—I won't say how many: "Keep the key bar, hand, wrist and fore-arm in a straight line, move from the wrist and keep as many finger ends on top of the key knob as possible." Usually two fingers will go on, but some wider knobs might take three. The thumb to the side, of course.

My patterns were made from several small pieces of wood nailed together. Small pieces of dowel could be used to provide the wide section of the key bar.

[Details of mounting given by VK-3AXU in the article "A Drop of Home Brew," which appeared in Feb. 1972 issue can be used with a little modification for this unit. Assume all castings are of brass.—Tech. Ed.] ●



KEY BAR



CENTRE BLOCK

FRONT & REAR STOP

NEWCOMER'S NOTEBOOK

With Rodney Champness,* VK3UG

"YOUR RADIO REFERENCE LIBRARY"

"I don't need a reference library. I passed the theory exam. (just) and I intend to operate a commercially made rig and aerial system. Just quietly, I don't think I should have had to pass a theory exam. After all, I'll be operating commercial equipment and everyone knows that commercial gear is perfect, not like this shocking home-brew stuff. I'll send the gear away for service or con one of the local experimenter types to fix it for me. That reminds me, I must get Joe Blow around to solder up that wire on the rotator."

The learned thoughts of an avid appliance operator "Ham"??? Look up a dictionary to see what "Ham" means —you may get a surprise. The thoughts above seem to me to indicate the attitude of a growing number of Amateurs —a rather narrow selfish attitude, not destined to help Amateur Radio in the long term. Don't get me wrong, I have nothing against Amateurs operating commercial apparatus, only against those who know nothing about the internals of their rigs; those too frightened to open the lid of their set in case it goes "boo" at them. That type of chap won't read this article in any case.

The point I want to get across is this—that to be a competent Amateur in the true sense of the word, a working knowledge of your equipment is essential. To help you gain this knowledge a small reference library is essential.

What kind of books are necessary for this reference library? Two books which cover the wide spectrum of Amateur Radio in its many facets are "Radio Communication Handbook" by R.S.G.B., and "The Radio Amateur's Handbook" from A.R.R.L. Naturally enough you will have a leaning towards some particular aspect of Amateur Radio which will mean specialised books are desirable.

If you are just starting, "Understanding Amateur Radio" A.R.R.L. as a general text is quite good. To prepare you for examinations the N.Z.A.R.T. publication "Questions and Answers" is quite helpful—as long as it is understood that a difference exists between New Zealand Amateur examinations and ours. A small but good book on aerials is "S-9 Signals". This book has quite a few simple inexpensive aerials to suit a light weight wallet. I have been told that this book is now out of print, but I notice that most of these aerials are included in "Beam Antenna Handbook" (4th), by William Orr.

If your main interest is in v.h.f. the "V.h.f./U.H.F. Manual" by R.S.G.B., or "Radio Amateur V.H.F. Manual" (11th) by A.R.R.L. can be recommended. I do prefer the British texts as the power levels and financial levels are similar to ours. All the above books are readily available. Write away for lists and you will find several other books of interest for your particular activity.

The knowledge you gain from your reference library will help you to establish and operate your station more conveniently, effectively and efficiently, thus giving you considerable satisfaction. ●

* 34 O'Dowds Road, Warragul, Vic., 3820.

WIRELESS INSTITUTE OF AUSTRALIA YOUTH RADIO CLUBS SCHEME

A Special "A.R." Report on the Y.R.C.S. Conference

The Y.R.C.S. Conference held in Melbourne over the week-end of 2nd and 3rd September laid special stress upon the basic reasons for the existence of the Y.R.C.S.—namely, the best interests of youth. A Y.R.C.S. Constitution was negotiated for submission to the Federal Council for their acceptance.

The Conference was hosted by the W.I.A. Victorian Division and Mr. John Battrick, VK3OR, was elected by the delegates as Chairman in the unavoidable absence of the Federal President, Mr. Michael J. Owen, VK3KI. Later in the evening, Dr. David Wardlaw, VK3ADW, was elected to the Chair when Mr. J. Battrick left with regret on another commitment.

The delegates were the Federal Y.R.C.S. Co-ordinator, Rev. R. G. (Bob) Guthberlet, of South Australia; the Federal Y.R.C.S. Secretary, Mr. J. Flynn; State Y.R.C.S. Supervisors: Mr. D. S. Jeanes, VK2BSJ, of New South Wales; Mr. R. A. Everingham, VK4EV, of Queensland; and Mr. A. M. Dunn, VK5FD, of South Australia; Mr. W. L. Tremewen, VK3ZCI, the Y.R.C.S. Correspondence Section Supervisor; Mr. K. McLachlan, VK3ZDK, State Supervisor of Y.R.S. of Victoria, with helpers Mr. Keith Nicholls, VK3ANI, and Dr. Bob Callander, VK3AQ, who demonstrated the Y.R.S. b.f.o. unit project advertised elsewhere in this issue. Comments in writing from the unavoidably absent VK6 and VK7 State Y.R.C.S. Supervisors were also taken into consideration.

This meeting of the Y.R.C.S. Council, as it is to be known under the new Constitution, clarified a number of long outstanding questions including the name of the scheme as "The Wireless Institute of Australia, Youth Radio Clubs Scheme" (abbreviated Y.R.C.S.), the supply of authorised notes to be prepared by the Y.R.S. of Victoria for distribution through the Executive office and the appointment of a committee to revise, integrate and standardise Y.R.C.S material.

Duties of the functionaries and the necessity for constant communication and co-ordination received attention in addition to other diverse matters such as certificates, Y.R.C.S. Council meetings each three years or lesser period, copyright, "Zero Beat" and general publicity material.

☆

MODERN FILTERS

(Continued from Page 13)

The tools for calculation or design of filters and tuned amplifiers grow most easily out of these pole-zero patterns (and the mulitiplier). The Filter Tables to follow are based on extensions of these ideas.

[Editorial Note: The principles of S-plane analysis and synthesis are of necessity beyond the scope of this series. Readers who wish to study the subject are referred to the bibliography which will follow Part 3. In addition, a very readable introduction to S-plane concepts may be found in Holbrook, "Laplace Transforms for Electronic Engineers" (Pergamon, 1966), particularly chapters 1 and 8.] ●

Commercial Kinks

With Ron Fisher,* VK3OM

This month, Part Three of the FT200, some modifications on the Marconi R1155 receiver, but first off, some data on carphones. Following my plea for information on these, Peter Campbell, VK2AXJ, answered my prayer and how! I can now supply circuits for the following A.W.A. units. Low band: MR10C/20A, MR15A and MRT25A; high band: MR10C/20A, MR20B, MR15A, MR6A, MRT25A, MR3A, MR10B. If you would like a copy of any of these, drop me a note with details of your requirements, plus an s.a.e.

Peter also forwarded conversion information on A.W.A. carphones and this will be published over the next two issues.

CONVERSION OF A.W.A. CARPHONES

High band MR10B to 146 MHz. Transmitter: increase IC14 to 82 pF., IC12 to 47 pF., IC21 to 15 pF. Add 4.7 pF. across the secondary of IT2 pins 2 and 3. Add 2.2 pF. across both primary and secondary of IT3. Close up IL4 and IT6A as required. Receiver: Increase C15 and C16 to 33 pF., C31 to 22 pF. Rewind both primary and secondary of T9 with 6 turns.

High band MR10C and MR20A to 146 MHz. Transmitter: T8 increase C92 to 22 pF., C89 to 33 pF. Add 2.2 pF. across L9. Close up L11, L12 and L16 as required. Receiver: Add 1.8 pF. across L1. Add 1.8 pF. across L5. Increase C54 to 15 pF. Increase C6 and C7 to 39 pF., C58 to 22 pF.

High band MR20B to 146 MHz. Transmitter: Increase C117 to 39 pF., C118 to 22 pF. Add 2.2 pF. across L9. Close up L11. Receiver: Add 1.8 pF. across L1, L3 and L6. Increase C66 to 47 pF., add 4.7 pF. across primary of TR2 and secondary of TR1.

High band MR3A to 146 MHz. See October 1965 "Amateur Radio" or contact Commercial Kinks for a copy of the details. More carphone conversion details next month.

THE FT200, PART THREE

Here is the last part of the service data on the FT200 as supplied by Mr. Fred Bail, of Bail Electronic Services.

Symptom: No drive on "Tune". No side tone on c.w. position, but meter kicks up with speech on s.s.b. This fault is sometimes of an intermittent nature, but it is normal for the drive on "Tune" to diminish slightly if the set, and thus the audio oscillator, becomes very hot. Probable cause: Failure of the audio tune-up oscillator. Cure: Re-adjust the oscillator feedback preset pot. VR504. A slight adjustment of the output preset pot. is sometimes sufficient. Both these controls are mounted on the oscillator printed circuit board under the chassis. If the above adjustments are not effective, check other components and voltages on the board. Until the fault is rectified, the transmitter can be tuned up in the a.m. position. The carrier insertion can be adjusted with a.m. carrier level pot. at the rear of the chassis.

Symptom: Transmitter self oscillation on 21 MHz. band only. This shows up as constant high Ic meter reading at no drive condition. Probable cause: Misadjustment of L22 trap. Cure: Adjust as per the instruction book. If the transmitter self-oscillation still persists, slightly back-off the L22 adjustment until the oscillation just ceases.

Symptom: Transmitter self oscillation. High Ic meter reading at no drive condition. Ic reading varies with grid and plate tuning. Probable cause: P.a. neutralisation out of adjustment. Defective 12BY7 driver valve. Excessive voltage on 12BY7 driver valve. Cure: Connect the transmitter to a load, preferably to a 50/75 ohm dummy antenna. First tune the transmitter on 21.3 MHz. with an Ic meter reading of about 100 to 150 mA. Adjust the p.a. neutralising condenser TC-3. Adjust TC-3 so that Ic dip at p.a. resonance coincides with maximum r.f. output. Check 12BY7 driver valve. Try a replacement. Check that the 300v. line in the FP200 is not reading high. If it is, modify the 300v. filter section to a choke input type.

Although that finishes the service data on FT200s, it is by no means the end of the FT200 in Commercial Kinks. I will be back next month with plenty of ideas for you to try out on your rig. Don't forget to tell me of any problems or modifications relating to the FT200.

THE R1155 AND 160 METRES

My thanks to Mr. R. G. Edmeades for the following notes on the R1155 receiver.

"After suffering from QRM when using the broadcast band as a tunable i.f., it was decided to adjust the broadcast band of the 1155 to include the 160 metre band. Here is how it was done.

"Turn the r.f. coil slug out as far as it will go. Turn out the two No. 3 coil slugs until the tops are just below the edge of the coil box. These are the 1st, 4th in the row nearest the front. Turn out the No. 3 trimmers two turns. Set the pointer to 628 on the dial, then tune oscillator slug (1st on the left) until the set tunes to 730 kHz. Now peak the mixer coil slug (4th from the left). Turn the dial pointer to 1325 and turn the oscillator trimmer until 1600 kHz. is heard Peak the mixer and screw out the r.f trimmer until it has no further effect.

"This is the limit of adjustment and the set now tunes from 700 to 1900 kHz. This provides a tuning range of 1600 to 1900 kHz. for use with converters, giving very little chance of QRM from break-through. A new paper scale can be pasted over the old broadcast calibrations."

In a later thought Mr. Edmeades says that some improvement can be achieved by cutting off half of the r.f. coil slug. To do this, remove two screws and the metal cover. Mark the top of the pot, so that it can be replaced as is. Remove the long clamp screws and lift off, unscrew the slug and cut half of it off. You will now be able to peak the trimmer at 1600 kHz.

Thanks Mr. Edmeades. I am sure this will be most useful to all 1155 owners. If you want more data on 1155s, consult the September 1960 issue of "Amateur Radio," or contact Commercial Kinks for copies of this.

* 3 Fairview Avenue, Glen Waverley, Vic., 3150.

Simple Linear Traps

FOR TRIBAND BEAMS AND VERTICALS

J. HUMPHREYS, VK3ANH*

● These traps have been used in a G4ZU X-beam. They have proven to be light, easy to construct and tune, strong, and effective in operation.

The trap capacitors consist of aluminium tubing of different diameters separated by plastic tubing as a dielectric. The inductors are short, straight lengths of aluminium wire connected gamma-match fashion across the capacitors. A sliding shorting bar between the wire and the tubing tunes the traps and the antenna.

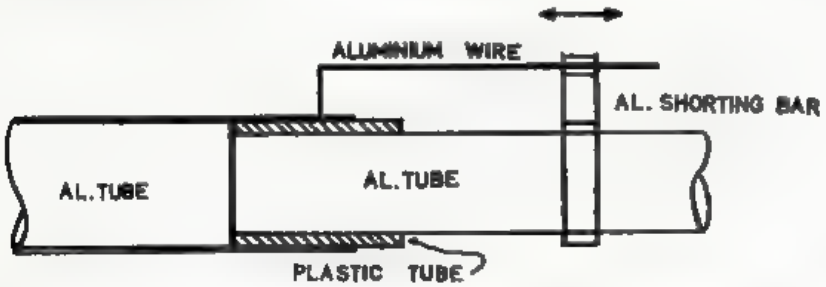
"The Antenna Book" (1970) describes a tubular capacitor formed from short pieces of tubing which are then built into the antenna. A simpler method is to make the 10 metre dipole from 1½" tubing. Into the ends of this go 4" lengths of 1" grey plastic conduit. Aluminium tubing, ¾" diameter, is wrapped with plastic tape to give a snug fit when inserted into the conduit. It extends the length to a half wave at 15 metres. For the next capacitor, 5" of ½" conduit are used. The length is made up to a 20 metre half wave with ½" and ¾" aluminium. These dimensions give capacitors of about 60 pF. at the ends of the 10 and 15 metre dipoles.

Worm screw hose clamps were used to join the various tubings and to hold the inner end of each inductance. Shorting bars were bent up from aluminium sheet and held with cadmium plated screws. Each trap then looks something like the diagram.

Tuning the antenna for s.w.r., gain or F/B ratio is a breeze. About 2" movement of the shorting bar will tune right through each band. Theory suggests that the 10 metre section be tuned first, but I found no indication that the tuning of one band affected the others. One point; believing that, like most traps, these would require the antenna to be shortened somewhat, I made the 10 metre dipole 14 feet, the 15 metre section 19 feet and the overall length for 20 metres 26 feet. When I came to tune the system on 20 by adjusting the length of the outermost section, I found it necessary to increase the length to a full 34 feet. This suggests that the 10 and 15 metre sections could have been made full size. However, their lengths are not critical because tuning the traps will compensate for any error in this regard.

[Careful checking indicates theoretical stub lengths of about 26" and 16", rather than 20" and 15". It appears that the discrepancy was compensated for by the re-adjustment of the shorter elements which were found necessary. —Tech. Ed.]

THE LINEAR TRAP



For the inductances, referring to a table of transmission lines, aluminium wire (e.g. 14 s.w.g.) spaced 2½" from the tubing will form a line with a characteristic impedance approximately 400 ohms. The inductive reactance of a length of shorted line is given by:

$$X_L \text{ (ohms)} = Z_0 \tan \phi$$

where Z_0 is the characteristic impedance and ϕ is the length of the line in electrical degrees.

From this, it can be found that lengths of something less than two feet will give the necessary inductance to resonate with the capacitors on 10 and 15 metres. In my case, after tuning, the lengths were 15" on 10 metres and 20" on 15.

In passing, I can recommend the G4ZU X-beam for home-brew tribanding. Because of its shape, the effective spacing on all bands is the same (in wavelengths) and, using these traps, it will match nicely into a single co-ax. feed line. ●

* 2 Vine Street, Ballarat East, Vic., 3350.

Letters to the Editor

Any opinion expressed under this heading is the individual opinion of the writer and does not necessarily coincide with that of the Publishers.

Editor "A.R.," Dear Sir,

I refer to QSP in the June publication of "Amateur Radio".

For some months I have read and listened to various attacks on local manufacture of Ham Equipment. I have been content to sit, like a wise monkey, however, your June QSP prompted me to put pen to paper.

I am the owner of a locally produced transceiver of excellent capabilities. During my period of ownership of one of these transceivers, I have heard at least six similar units operated in N.S.W. and two in Victoria. I still operate my unit, which sold at $680.00 (your advertising records and printing blocks will verify this) as my original enquiries to the manufacturer were made after reading large prominently displayed adverts in our journal "Amateur Radio". Does history repeat itself?

The June edition of "Amateur Radio" gives prominence to QSP which is conspicuous by its inaccuracies, at the same time displaying a highly paid advert (not so prominent) from another local manufacturer.

One wonders whose face is red! And will this letter receive equal prominence.

—R. Egan, VK3ARE.
W.I.A. member.

P.S.—I have been a full member since 1946, one would like to keep the records straight.

[The locally produced transceiver referred to was advertised in 1962 at a price then of £346/10/0. No trace can be found of any recent advertising of this item, but a reference can be found to a price on page 19 of September 1971 "A.R." Readers should also refer to (a) Currently advertised prices of imported transceivers as read with the final paragraphs of Dr Goding's QSP in June 1972 "A.R." and (b) To a Customs Import Duties article on page 11 of September 1971 "A.R."—Ed.]

CONTESTS

With Peter Brown,* VK4PJ

REMEMBRANCE DAY CONTEST, 1972

Well the 1972 R.D. Contest is over and a couple of days later there was a pile of logs waiting for me. A busy time ahead I guess.

A few days before the contest commenced I was asked if repeater contacts were permitted. My answer was "Yes," but I wish that I had put the ruling in the contest rules. My feelings are that where no individual gains, any of the usual means of radio communication are acceptable. In the R.D. a Division may gain. In the Ross Hull an individual will gain. There is no reason why r.t.t.y. and slow scan cannot be used also. Unless you think otherwise.

Before we get steamed up and waste efforts, let us see what the results show. Many dedicated Amateurs have spent a lot of time devising formulas and rules to make the R.D. Contest enjoyable and fair to all, but it all gets back to you.

Again read Federal Vice-President David's QSP of August "Amateur Radio". Please express yourself to your Federal Councillor, preferably, or to me and I will try and make contests to suit all. These minor changes are feelers.

Overall conditions seemed pretty good for the contest and did you note the high log numbers? Unfortunately, I was ill and could not fully participate, thus missing a few of my usuals, but I did get some comments.

"I did not think that I would see the day when congestion on the c.w section would send me into the phone band." "Fancy a pile up on 10 metres?" (There were pile ups on 15 metres also.) "Of a 100 contests, this was the best yet."

The ZL/ZM boys seemed to be enjoying the contest.

What about a bonus to get signals on 160 and 11 metres next year?

As a final comment, I always feel sorry for the operator, especially one with a good score, whose contest logs fail to reach me, but there is nothing anybody can do about this particularly where the closing date has passed and results have been published. How can this situation be avoided? Certified mail by the sender perhaps?

ROSS HULL MEMORIAL VHF-UHF CONTEST, 1972-73

The major change in this year's contest is from E.A.S.T. to G.M.T. There is little need for me to elaborate on the advantages with "Daylight Saving" coming to some States. Quite a few wished a return to G.M.T. anyhow.

The two-hour elapsed time between contacts with the same station on the same band has been introduced to permit two contacts per calendar day. We will see if this helps.

There is no loading for c.w. as in the R.D. Contest because as a v.h.f./u.h.f. contest the Limited licensees would be at a disadvantage. The rule restricting the use of repeaters has not been altered because this is an individual effort contest. If we do not get a better return than last year from sections (a), (c) and (d) in this contest, perhaps these should be eliminated the year after.

You will note that you have five weeks to get your entry into my hands. After 23rd February I will be too busy getting results to April "Amateur Radio" to open other logs.

Don't put off writing your log—it will be later than you thought. You will note there is a variation in certificate issue. Certificates for merely entering the contest appear to be undesirable. I hope that I can put on a signal or two myself this year and will look forward to saying "good day" to you.

JOHN MOYLE MEMORIAL NATIONAL FIELD DAY CONTEST, 1973

I am sure we can make our next Field Day Contest the best yet. The ZL/ZMs have their Field Day on that week-end also and although they have a few limitations compared with our contest, about which I will make mention next month, there should be a lot of activity for both of us. I have written to Jock ZL2GX on a common Field Day and perhaps one year we can have common rules.

In our next Field Day Contest I would like to define more clearly the "Field" station for two reasons. One being to stop a drift from

(Continued on Page 23)

* Federal Contest Manager, Box 638, G.P.O., Brisbane, Qld., 4001.

Ross Hull Memorial VHF-UHF Contest, 1972-73 Rules

The Federal Contest Committee of the Wireless Institute of Australia invites all Australian and Overseas Amateurs and Short Wave Listeners to participate in this annual contest which is held to perpetuate the memory of Ross Hull whose interest in v.h.f./u.h.f. did much to advance the art.

A Perpetual Trophy is awarded annually for competition between members of the W.I.A. in Australia and its Territories, and is inscribed with the name and life work of the man whom it honours.

The name of the winning member of the W.I.A. each year is also inscribed on the Trophy. In addition, this member will receive a suitably inscribed certificate.

Objects. Australian Amateurs will endeavour to contact as many other Amateurs as possible under the following conditions.

Date of Contest. From 1401 hours G.M.T., 9th December, 1972 (0001 hours E.A.S.T., 9th Dec.) to 1400 hours G.M.T., 21st January, 1973 (2400 hours E.A.S.T., 22nd Jan.)

Duration Any seven calendar days (local) within the dates mentioned above, not necessarily consecutive. These periods are to be at the operator's convenience. A calendar day is from 1401 hours G.M.T. to 1400 hours G.M.T. (0001 hours E.A.S.T to 2400 hours E.A.S.T.)

RULES

1. There are two divisions, one of 48 hours duration and one for seven days. In the seven-day division there are four sections.
   (a) Transmitting, open.
   (b) Transmitting, phone.
   (c) Transmitting, c.w.
   (c) Receiving, open.

   In the 48 hours division the best score over any 48 hours period is the winner.

2. Any Australian or Overseas Amateurs operating fixed, mobile or portable may enter.

3. All Amateur v.h.f./u.h.f. bands may be used but cross-band contacts are not acceptable. Only single frequency operating at any one time is permitted. Cross mode contacts are permitted.

4. Amateurs may enter for any one of the sections. The seven-day winner is not eligible for the 48-hour award.

5. Two contacts per band per day are permitted provided that two hours elapses from the previous contact with that station on that band.

6. A multi-operator station will not count, only one may operate a station at any one time and submit a log for his own operation.

7. Entrants must operate within the terms of their licence.

8. The exchange of serial numbers consisting of RS or RST report plus three figures commencing with 001 shall be proof of contact.

9. Entries should be set out, on quarto sheets using one side of the paper only, and must be forwarded to reach the **W.I.A. Federal Contest Manager, G.P.O. Box 638, Brisbane, Qld., 4001,** in time for the last opening of logs on **23rd February, 1973.** Envelopes should be clearly marked "Ross Hull Contest". Early logs will be appreciated.

10. Scoring will be based on the attached table and the table of distances published in November 1971 "Amateur Radio". Approximate distances are to be shown in the log. Operation via repeaters or translators is not permitted.

11. Logs should be as set out in the example and must carry a front sheet showing the following information:

Name ... Section ...
Address ... Call Sign ...
....Claimed 7-day score
Operating dates ...
Highest 48-hour score ...
Operating period ...
I hereby certify that I have operated in accordance with the Rules and spirit of the Contest
.....
Comments.....

12. All times are to be logged in G.M.T.

13. Certificates may be awarded to the winners of each section of each call area.

Certificates will be awarded subject to there being at least three other eligible entries in that call area and section. Certificates will be awarded to contestants who break any Australian v.h.f./u.h.f. distance records.

The VK contestant who returns the highest score in the transmitting section and who is a financial member of the W.I.A. will have his name inscribed on the trophy which will be held by his Division for the prescribed period. A certificate will be awarded to the operator with the highest 48-hour score.

RECEIVING SECTION

1. Only short wave listeners may enter for this section.

2. Contest times and logging of stations shall be as for the transmitting section except that there will be no 48-hour division.

3. Logs must show the call sign of the calling station, the serial number given and only the call sign of the other station. Scoring will be as for transmitting stations.

4. Any scoring contacts may be logged. There is no limit to the number of times that a station may be logged provided that they are scoring contacts, i.e. there are serial numbers.

5. The logs for any seven calendar days may be submitted and the winner of the section will be the highest scorer.

6. Certificates will be awarded to the highest scorer in the contest provided that there are at least three other eligible entrants.

7. A certificate will be awarded to the club station with the highest seven-day score provided that there are at least three eligible club entrants.

GENERAL

It is preferable that complete logs be submitted as an aid in checking, but contestants must clearly show their best seven days or 48 hours.

SCORING TABLE

Distance	52 MHz.	144 MHz.	420 MHz.	576 MHz.	Higher
Up to 25 miles	1	1	2	5	10
26 to 50 "	1	1	5	10	25
51 to 100 "	5	5	15	30	50
101 to 200 "	10	10	25	50	100
201 to 300 "	25	15	50	150	250
301 to 500 "	20	25	100	250	300
501 to 1000 "	10	35	200	300	350
1001 to 1500 "	15	100	250	350	400
1501 to 2500 "	25	125	300	450	500
2501 to 3500 "	35	200	400	500	600
3501 to 5000 "	50	300	450	550	650
5001 to over "	100	400	500	600	700

(When we change over to metric, these distances will be changed so you won't always be just in or just out of a range.)

EXAMPLE OF VK4 TRANSMITTING LOG

Date/ Time GMT	Band MHz.	Emission	Call Sign	RST Sent	RST Recd.	Dist. Miles	Pts.
Dec 24							
1402	52	A3(a)	VK7ZAB	58001	57022	1234	15
1424	52	A3(a)	VK4OP	57002	54004	330	20
1534	144	A3	VK5ZDL	58003	58043	980	35
1855	144	A3	VK3ZHD	45004	57099	175	10

EXAMPLE OF VK6 S.W.L. RECEIVING LOG

Date/ Time GMT	Band MHz.	Call Heard	RST Sent	Station Called	Dist. Miles	Pts.
Jan 2						
1207	52	VK5ZXG	58087	VK6OK	1330	15
1400	52	VK2ZDD	56244	VK6DB	2450	25
1815	432	VK6JX	57061	VK6TG	80	15
2308	144	VK5RF	47004	VK6ZDO	1330	100

PROJECT AUSTRALIS

Unfortunately, a serious component failure in the 435.1 MHz. beacon transmitter delayed shipment to Amsat. Notwithstanding the statement on page 2 of August "A.R.," the transmitter has not yet left Australia. Long discussions on the problem have been held with Amsat, and it has been agreed to replace an offending FET with a different type. It is hoped that this will maintain the good performance figures of the transmitter, while still giving the unit the reliability needed for the AO-C Satellite. It is hoped to get the transmitter to Amsat in time to have it included on AO-C.

Amsat have advised that AO-C will begin RFI (radio frequency interference) tests with the Nimbus-E Satellite on 2nd October, and that it will then be shipped to California for a long series of pre-launch tests on 15th October. The launch date has not yet been completely finalised.

Amsat have advised that the AO-C absolute receiver sensitivity is minus 100 dbm. for maximum output of the 10 metre transmitter. This is equivalent to 2.5 microvolts. To a ground station, this is equivalent to 100w. e.r.p. The maximum output of the flight transmitter on AO-C is 1.1w. Assuming a 1w. output and 136 db. path loss, the signal at ground stations at maximum short range of 2,500 miles is 1 microvolt. As the average sensitivity of a commercial h.f. transceiver at 10 metres is 15 microvolts, a pre-amplifier WILL be needed. A suitable pre-amplifier will be published in November "A.R." as will a 10 metre to 40 metre converter. Both of these will be available in kit form.

The prototype 435 MHz. repeater has so far been to VK4 and VK5 on its tour around the country. It next goes to VK3, then VK6 and VK7.

The standard orbit tracking data will be published with October "A.R." Data will appear for each State capital. If you know of any district more than about 100 miles from a State capital which would be interested in getting a copy of the standard orbit data, please let us know, so that it can be prepared and posted out in advance of the AO-C launch.

STOP PRESS

AO-C is now due to be launched October 15 or 16 on ITOS-C or ITOS-D (REPEATER OPERATORS PLEASE NOTE).

INTRUDER WATCH

With Alf Chandler, VK3LC

I have had some complaints that run something like this:

"How about telling us when a station is removed from our bands because of Intruder Watch vigilance?" This is very difficult because the authorities do not tell us when such is the case.

Another complaint is: "We report these intruder signals but nothing seems to be done about them." Again this is very difficult because the authorities will take no action unless they get many reports of the same station being heard and at various dates. Then they will monitor the frequency in question, and if satisfied that it is a legitimate intruder causing harmful interference they will take action and send a diplomatic complaint to the Administration concerned.

Thus it is necessary for as many members to report intruders as possible. Without your reports, nothing can be done. Of the Divisions, VK4 is the most active and informed, VK2 and VK3 are only slightly interested as is VK7, VK5 and VK6 Amateurs appear to have no interest in I.W.

The I.W. Summary for the first half of 1972 lists 275 intruders, of which 106 were on 14 MHz., 30 on 7 MHz., 21 on 21 MHz. and 18 on 3.5 MHz. These were reported mainly by VK4KX and VK3HA. Contributions came also from VKs 4PB, 4BG, 4CA, 4LZ, 4NP, 4UC, 2AXK, 2ZO, 4VO, 3TX and 3ASV. On 40 mx the broadcasters are listed including an Indonesian station on 7099 and the ever-present Chinese language stations together with jammers. Most of the intruders on 14 and 21 MHz. were logged in daylight hours, whereas the opposite occurred on 40 and 80 metres, thus illustrating the mess which comes from areas somewhere to the north of us.

The list has been passed to the P.M.G. Dept., but what action is taken thereafter does not appear to achieve much result except that more and more intruders are being logged. However, we must keep up the reports to avoid a squatter's rights situation for the intruders.

An interesting item is contained in "Radio Communication," July 1972, page 446: "A radio station may operate in derogation of the Radio Regulations as long as its operation does not cause harmful interference to the radio communication services operating in accordance with the convention and regulations. This means that a commercial station may operate in an Amateur band and may continue to do so unless a report of harmful interference is made to the Administration. From this basic fact stems the need for an active and efficient intruder watch." Go to it or you'll surely perish!!!

"20 YEARS AGO"

With Ron Fisher, VK3OM

Atomic tests always seem to be making news one way or another. Back in 1953 tests were carried out at the Monte Bello Islands, and in the Editorial of October, Federal Executive urged Amateurs to make observations of any unusual propagation conditions.

Federal Executive went on to suggest that perhaps we should be helping to fill in the gaps which would enable the Ionospheric Prediction Service to provide even more accurate results than "at present" achieved. Perhaps we should.

Tucked away in the Federal Executive Proceedings column is news of the release of the 160 metre band for emergency work. The allocation was from 1840 to 1880 kHz. I do not remember anyone ever making use of the band, probably because most Amateurs were unaware of just how they could legally use it. 160 was destined to remain silent for a few years yet.

Another item of far reaching interest concerned Novice and Technician licences. Consideration was given to a letter received from the Postmaster-General's Department, Wireless Branch, in reply to the W.I.A.'s application for approval for issuance of Novice and Technician licences. The Department advised that since reference to other administrations and departments would be necessary, inquiries were likely to be protracted. As we know, the Limited licence was introduced a few years later, while the Novice licence still remains an issue.

Leading the technical articles, R. T. Busch, VK3LS, presented a run down of circuits suitable for emergency network use. Simple transmitters, modulators, receivers and mobile aerial systems were discussed.

During the 1950s the "All Models Exhibition" was a popular feature of Melbourne life. The Victorian Division of the W.I.A. was well represented and a complete description of their display appeared in the October 1952 issue of "Amateur Radio". The whole stand was organised by Len Moncur, VK3LN. Exhibits included transmitters and receivers for all bands, a complete television system and a tape recorder—all home made.

It seems rather a pity that these Exhibitions were dropped as it certainly gave the W.I.A. a wonderful opportunity to put Amateur Radio on display to the public.

In 1952, band switching an h.f. transmitter presented something of a problem. An interesting advertisement by R. H. Cunningham Pty. Ltd. showed the range of Q Max turret switched pa. coil assemblies. These units employed a separate coil for each band complete with a separate output link coupler. Rather large when compared with current methods, but no doubt efficient.

FREQUENCY ALLOCATIONS

Band Usage Questionnaire

The W.I.A. has recently established a committee to be responsible for the orderly planning of frequency usage for various Amateur purposes in the v.h.f. and u.h.f. bands, 52-54 MHz., 144-148 MHz., 420-450 MHz., and higher. Problems have arisen recently in the 144-148 MHz. band due to the conflicting channel requirements of established f.m. repeaters and the soon-to-be-launched Oscar 8 satellite, not to mention channels used for f.m. simplex communication, r.t.t.y., and other activities.

Re-organisation of the 2 metre band, because of its urgency, is to be the first task of the committee, which is known as the V.h.f. Advisory Committee, and functions as part of the Executive of the W.I.A. Obviously one of the aims must be to reconcile the needs of the various users, where conflict may exist, so as to produce the minimum of inconvenience to those already established. Planning must be carried out at least on a national basis, and particularly for satellite, moonbounce, or similar systems, there are international aspects involved.

As the first stage in the programme, data is needed regarding the present usage and future requirements of the bands. It has been decided to obtain this by the wide distribution of a questionnaire to reach all known v.h.f. and u.h.f. band users. The questionnaire is now in preparation, and will also be distributed to all v.h.f. groups, radio clubs, and similar organisations. The committee earnestly requests interested parties to study the questionnaire when received, and to supply the data called for as thoroughly as possible. One important aspect is to provide for newly-developing systems such as slow-scan t.v., facsimile, or other techniques which some users may hope to experiment with in the future. Although the 2 metre band has been emphasised, information will also be sought regarding other bands.

Only with the fullest possible knowledge of current and potential activity by Amateurs on v.h.f. and u.h.f. can the committee achieve its task of providing for all with minimum inconvenience. Success depends on co-operation. Only those who tell us of their frequency requirements can expect the final plan to have a place for them. May we, the Advisory Committee, hope to hear from you all in due course?

Magazine Index

With Syd Clark, VK3ASC

"QST"—JUNE

450 Cubic Centimetres of New Front End for Your FM Receiver (220 MHz.), The W2FMI 20 Metre Vertical Beam; More on Instant Voice Interruption; Antenna Impedance by Direct SWR Measurement; A Simple Ham Shack Wavemeter, Notes on the Amateur Station Counter; CB Whip plus Mod equals 2 Metre 5/8 Wave Vertical; An IC Audio Tune-up Device for the Blind Amateur; An Adjustable Voltage, Current Limited Power Supply (0.5-31v., 0-1.1a.), High Accuracy FET Dipper; Taking Out the 2 Metre Garbage (can coaxial on 144 MHz.), Review of "Henry" 2K Ultra Amplifier; Do You Really Dig Transistors?, Houston, This is Apollo . . . ! (how Amateurs may equip themselves to receive signals directly from space vehicles).

"HAM RADIO"—JUNE

Five-Band Solid State Communications Receiver (converter 7-30 MHz., 80 tunable i.f., Collins 3.1 kHz. filter 1 f., TA300 audio); Integrated Circuit, Sequential Switching for Touch-Tone Repeater Control, RTTY Ribbon Re-inkers; Accurate Noise Figure Measurements for VHF, Sync. Generator for SSTV, Getting Started in Microwaves, Memo-Key.

VHF UHF

an expanding world

With Eric Jamieson,* VK5LP

Closing date for copy: 30th of month. Times: E.A.S.T.

AMATEUR BAND BEACONS

(This list will be published in full every third month.)

VK0	53.100	VK0MA, Mawson.
	53.200	VK0GR, Casey.
VK1	144.475	VK1VF, Canberra.
VK2	53.450	VK2WI, Dural.
VK3	144.700	VK3WI/R8, Vermont.†
	144.925	VK3QZ, Traralgon.†
VK4	53.400	VK4WI/2, Townsville.
	144.360	VK4WI/R1, Toowoomba.
VK5	53.000	VK5VF, Mt. Lofty.
	144.800	VK5VF, Mt. Lofty
VK6	53.006	VK6VF, Bickley.
	53.800	VK6TS, Carnarvon.
	53.950	VK6VE, Mt. Barker.
	144.800	VK6VE, Albany
	145.000	VK6VF, Bickley.
VK7	144.000	VK7VF, Devonport.
VK8	53.300	VK8VF, Darwin.
ZL1	145.100	ZL1VHF, Auckland.
ZL2	145.200	ZL2VHF, Wellington.
	145.250	ZL2VHP, Palmerston North.
	491.850	ZL2VHP, Palmerston North.
ZL3	145.300	ZL3VHF, Christchurch.
ZL4	145.400	ZL4VHF, Dunedin.
JA	53.800	JA1IGY, Japan.
HL	50.100	HL8WI, South Korea.
ZK	50.1015	ZK1AA, Cook Island.†
KH6	50.104	KH6EQI, Hawaii.†
WB6	50.013	WB6KAP, California.†
FO8	50.101	FO8DR, French Oceania.†

† Denotes addition or change of information.

Copies of a letter from Victor Frank, WB6KAP, to hand per courtesy of Federal Manager, and Ross VK3KF, Secretary, VK5 W.I.A. This letter contains interesting information on operation of beacons as follows: ZK1AA, Cook Island, 50.1015 MHz. operates continuously and to call him you should transmit on 50.104 MHz. KH6EQI, Hawaii, on 50.104 also operates continuously, to call phone 689-0111 or 432-5132!! Beams West Pacific 1230 to 1400, S.W. Pacific 1400 to 1630, South Pacific 1630 to 0400. WB6KAP in California operates for first 30 seconds; then listens second 30 secs. on 50.101. Hours 1100 to 0100 week days, longer at week-ends. Beacon permit lasts from 15th August to 15th November. FO8DR in the French Oceania group to the east of Cook Is. operates continuously on 50.101, listens infrequently on the same frequency. Beams to ZK1 (and probably in line with VK) 0300 to 0315 and 1400 to 1415.

Victor WB6KAP further reports FO8DR and ZK1AA are hearing and working each other regularly on 50 MHz. scatter. ZK1AA has been hearing the KH6EQI beacon regularly since it returned on 10th August, as early as 1600 and late as 2330. FO8DR has heard KH6EQI weakly. All four stations would appreciate reception reports. WB6KAP also has a chart recorder going on 50.101 as well as a number of t.v. video carrier frequencies continuously, plus a tape recorder on 50.101 and 50.104 between 0300 and 2000. So far no VK or ZL t.v carriers heard this season . So! Looks like a good idea to run a receiver on some of the above frequencies at odd moments when poking around the shack, particularly during the equinox period.

The VK3VE beacon has been allotted a new call sign of VK3WI/R8. The VK3QZ beacon at Traralgon may not be in operation until the early part of the DX season. Other than that, it is hoped the list as presented is reasonably complete and accurate. Of interest is the news that Roger Harrison, VK2ZTB, Editor of 6 Up, will be staying on the Cocos Islands in the Indian Ocean until about the end of 1972, and hopes to be able to operate 6 and 2 metre s.s.b. from there, and with the possibility of running some sort of beacon. The distances will be about 1,800 miles to VK6 and nearly 3,000 miles to VK5. Roger would like to try t.e.p. to Japan on 144 MHz. Call sign initially will probably be VK9YR, until his own is allocated. Apart from all this Roger wants to be active when the AO-C satellite is in orbit. Whether he will be working at all has not been indicated!

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* Forreston, South Australia, 5233.

144 MHz. CONTACTS

The 27th August provided a number of Adelaide stations with good contacts during a coastal inversion on 144 MHz. Kerry VK5SU at Ceduna surprised many with his signal on 144.200, and contacts were also made with stations in widely scattered areas like Port Lincoln, Whyalla, Port Pirie, Mt. Gambier, etc. VK3s seemed elusive but the inversion may not have extended that far, although David VK5ZOO in Mt. Gambier was 9 plus for a long time.

A letter from Rod VK2ZQJ mentions successful skeds being maintained with Barry VK3ZAY in Boggabri, North-West of Tamworth, and a 230-mile path, with at least a 50 per cent. QSO rising to 99 per cent. at times. Usual QSB and occasionally fast flutter. Barry runs 100w. to a 13 el. Rod is also contacting Bill VK2ZCV at Tamworth (100w.) with excellent signals two-way s.s.b. Both these stations could represent possible contacts on 2 metres during the summer Es season, and would be advised to keep one ear on the band during December.

[illegible] MHz.

Rod VK2ZQJ goes on to mention continuing useful sessions with VK7ZGJ on meteor scatter and particularly good signals during the recent Aquarids showers, with quite a lot of residual activity after the showers finished. He heard quite a lot of Wally VK3ZWW and VK5ZDX.

For your information days of likely increased meteor shower activity are Oct. 20 and 21; Nov. 16 and 17; Dec. 4, 5, 6, 12, 13, 14. According to 6 Up, the Giacobinids showers due Oct. 9, allegedly produce a count of up to 400 per minute during peak years. According to the m.s data in the latest A.R.R.L. V.h.f. Manual, 1972 is a peak year. Anyone for two metres?—or even 432?—m.s. on this band has been accomplished in the States!

VK3 six metre operators will be happier now that their "beloved" Channel 0 t.v. will not be commencing operation until 1130 instead of the previous 0700. If the same situation extends to the week-ends and the summer period a rise in VK3 short-skip contacts to VK3 is possible.

REMEMBRANCE DAY CONTEST

The R.D. Contest has been and gone. I considered it to have been one of the friendliest in my time of operating. Very pleasing to note the greatly increased operating on v.h.f. this year, in VK5 anyway. In this State 46 full calls and 50 limited licensees participated and there were some very good scores. With repetition contacts permitted every two hours, there is now more incentive for the v.h.f. operator to join in the contest which should be Australia's number one contest.

"S" BAND SIGNALS

Reprinted from Veron V.h.f. Bulletin, K2RIW, via "Break-In". Condensed to technical details only. In 1971 WB2MLH, WB2MUE and I, K2RIW, realised that around our laboratory was enough test equipment to receive Apollo astronaut "S" band signals if combined with a 30-35 dB. gain antenna. I had been developing a 22 pound, 12½ ft. diam. stressed parabolic antenna with 432 and 1296 MHz. feed horns for the annual East Coast V.h.f. Society Antenna Gain Contests.

For Apollo reception we built an "S" band feed for this antenna out of an American paint can and a Scottish oatmeal can (3¾ in. cans don't exist in the U.S.) The feed is modified from W2MIU's patented design. The antenna on "S" band has a 700 ft. beat field range, so we made our solar noise measurements and found we had to improve surface accuracy. After improvements we received 6 dB. of "S" band sun noise. My company loaned me a one dB. noise figure parametric amplifier and a spectrum analyser, which we used on 2287.5 MHz. Command Service Module (c.s.m.) frequency converter. We also built a phase locked loop synchronous detector for extraction of the astronaut voice 1.25 MHz. n.b.f.m. subcarrier before we were able to receive good audio.

On Apollo 15 we received 2½ hours of astronaut voice tape recordings. The c.s.m. carrier wave was as strong as 29 dB. over the noise. For Apollo 16 I built a new feed horn which uses a set of screws as a slow wave structure to achieve circular polarisation and thus did away with the lossy hybrid. The feed is supported by fibre-glass sheets instead of wire and is much more efficient. We now see 9½ dB. of "S" band sun noise and 2½ dB. of ground noise. With the 1 dB. n.f. paramp. we can easily see the "S" band noise radiated by a man when he walks in front of the antenna.

During Apollo 16 we received 15 hours of astronaut tape recordings from the c.s.m. We listened to the 2282.5 MHz. carrier of the Lunar Module (l.m.) during its landing. It was 5 dB./noise of a 0.5 kHz. bandwidth. We didn't receive l.m. audio because of the failure of their high gain antenna.

We found the one-watt carriers of the four science packages (ALSEP packages) which were left by the astronauts on Apollos 12, 14, 15 and 16. They were all 3 dB./noise of a 0.5 kHz. bandwidth on 2278.5, 2278.5, 2278.0 and 2278.0 MHz. respectively. What makes these signals interesting is that they are powered from a nuclear power source and should be operational for about 10 years. They transmit the best "S" band weak signals that are observable on a world-wide basis wherever the moon is observable, and they transmit 24 hours a day. If you can hear the ALSEP packages, then your system has more than enough threshold for astronaut voice reception at a lunar distance of the c.s.m. and l.m. If your antenna gain minus system noise figure is plus 32 dB., you can hear the ALSEPs. We borrowed a H.P. frequency counter and measured the four ALSEPs to the nearest 100 Hz. We were not successful in picking up the Lunar Rover Car.

The Goldstone 85 ft. dish transmits 10 kW. up to the c.s.m. at 2106.4 MHz. and to the l.m. at 2101.8 MHz. We listened to these signals after moon bounce and found them to be 15 dB. average over the noise of a 3.6 kHz. bandwidth during the time either vehicle was in front of the moon, even though their frequency was considerably outside the range of our horn and paramp. My tapes of this c.m.e. signal is the wildest sounding thing I have ever heard. It has fantastic amplitude gyration but manages to remain almost pure in pitch. This encouraged us to set up the n.b.f.m. rx on the 30 kHz. audio sub-carrier of the uplink c.m.e. signal and try audio demodulation. We achieved about 50 per cent. intelligibility of the l.m. uplink during the time the l.m. was lifting off the lunar surface. I am quite sure that f.m. c.m.e. phone is far superior to a.m. or s.s.b. c.m.e. phone because of the very rapid amplitude gyrations. We will be experimenting with a new technique to increase intelligibility of this signal on Apollo 17. If anyone wants to know what 2300 c.m.e. sounds like, then he should build a rx for 2106.4 or 2101.8 MHz. by 9th December, 1972, when Apollo 17 is due to lift off.

Solar noise measurements indicate that the system presently has a gain to temperature ratio of 35.6 dB. On 23rd May, 1972, at 7 p.m., EDST, we connected a radiometer to our rx system which is capable of seeing 0.005 dB of change in rx output. That increased the system sensitivity about 30 dB. When we aimed the antenna at the moon we measured 0.05 dB. of noise increase due to black body radiation of the moon's soil, which is at an average temperature of 220 degrees Kelvin. Besides the sun this is the first real radio astronomy measurement we have made and we are looking forward to measuring the Cygnus X and Cassiopeia A galaxies, and maybe even looking at the noise of a pulsar in the near future.

Our project is gaining momentum. My company is giving us increased backing in the form of borrowed test equipment during non-working hours and our informal "AIL Radio Astronomy Group" now consist of six members. Right now I am looking for 2300 transmitting devices. When Amateurs find out how many interesting things are possible on "S" band there will be a 2300 MHz. rush similar to the present 432 MHz. rush here in the U.S.—K2RIW

That's all the news for this month. In closing here is the thought for the month: "A bird in the hand may be worth two in the bush, but remember also that a bird in the hand is a positive embarrassment to one not in the poultry business." Until next time, The Voice in the Hills.

OBITUARY

RAY CHAPLIN, VK2SB

Mr. Ray Chaplin, VK2SB, of Epping, passed away very suddenly on 12th August with a heart attack on Kempsey Golf Course while playing. He was aged 52 and was employed as an engineer with the Macleay River County Council at the time of his death.

He operated as an Amateur from Nambucca Heads for 13 years and then moved to Epping where he stayed for about 30 years. For many years he was a co-organiser of the Urunga Conventions.

To his wife and daughter we would like to pass on our sympathy in their sad loss.

AWARDS COLUMN

With Geoff Wilson,* VK3AMK

INCREASED CHARGES FOR W.I.A. AWARDS

At the 1972 Federal Convention it was decided to increase the cost of W.I.A. Federal Awards to non members to $1.00 per award. However, there is NO charge made to financial members of the W.I.A. for awards issued by the W.I.A.

V.H.F AWARDS

With the approach of the summer season and increased activity on the v.h.f. bands I would like to mention some of the awards available to v.h.f. operators. Most people will be looking for a new State or Call Area on their favourite band in the coming months to gain some long sought award. In most cases the addition of one more Call Area on v.h.f. is much more difficult than another country would be to confirm on h.f.

The W.I.A. currently offers two main v.h.f. awards with others to become available in the near future. The first is the "V.H.F.C.C.," which requires one hundred confirmations. It is available for both 6 and 2 metre operation. Full rules were given in "A.R." Jan. 1972. The second is the "W.A.S.," which requires one confirmation from each VK Call Area 1 to 8. Full rules were given in "A.R." Feb. 1971. Additional credit is given for each "country" worked, countries for the purpose of this award are as for the Australian D.X.C.C. To date the "W.A.S." award has only been issued for 6 metres, but several people are known to be very close to achieving 2 metre "W.A.S."

The N.Z.A.R.T. (ZL) offer the award "W.A.D." for confirmed contact with ZL1, ZL2, ZL3 and ZL4 on any v.h.f. band or mixture of v.h.f. bands. The award is issued free of charge.

The J.A.R.L. (JA) offer three awards, which although difficult, are not impossible on v.h.f., especially for northern VK stations. The first is the "W.A.D." for confirmed contact with all JA districts 1 to 0. This has been obtained by a number of VKs. The second is the W.A.J.A." which requires confirmed contact with all 46 JA prefectures. The third, "J.C.C." requires confirmed contact with 100 JA cities. To prove that this is not an impossibility, Lyndsay VK4ZIM recently applied for "J.C.C." for 200 cities—all on 6 metres.

Applications for both ZL and JA awards may be certified by the Fed. Awards Manager W.I.A. so that cards need not be sent overseas.

In addition to the above awards, a number of VK clubs offer awards which are also available for v.h.f. operation.

W.I.A. D.X.C.C.

Listed below are the highest twelve members in each section. Position in the list is determined by the first number shown. The first number represents the participant's total countries less any credits given for deleted countries. The second number shown represents the total D.X.C.C. credits given, including deleted countries. Where totals are the same, listings will be alphabetical by call sign. Credits for new members and those whose totals have been amended are also shown.

PHONE—

VK5MS	319/344	VK5AB	295/314
VK6RU	317/344	VK2APK	292/300
VK4KS	312/328	VK4UC	292/300
VK3AHO	308/325	VK4FJ	285/307
VK6MK	302/324	VK4PX	284/286
VK4VX	300/301	VK4TY	283/288

New Member:

Cert. No.	Call	Total
136	VK3BBA	120/121

Amendments:

VK2AAK	275/279	VK4RF	229/230
VK2SG	263/265	VK3JF	139/140
VK2AHH	256/267	VK5WV	129/130

C.W.—

VK4HQ	309/325	VK3NC	272/297
VK2QL	304/325	VK6RU	264/289
VK3YL	291/309	VK3YD	262/281
VK2APK	288/297	VK4TY	258/272
VK4FJ	288/315	VK3TL	253/260
VK3XB	284/300	VK4VX	252/253

Amendments

VK3RJ	250/251	VK3JF	196/204
VK4RF	203/216	VK4PX	107/112

OPEN—

VKRU	317/344	VK4TY	305/321
VK4SD	314/330	VK6MK	302/324
VK3VN	313/333	VK4UC	301/303
VK4KS	313/333	VK2EO	300/325
VK4VX	307/306	VK2SG	299/306
VK2APK	306/319	VK4FJ	296/323

New Member:

Cert. No.	Call	Total
146	VK7GC	111/113

Amendments:

VK4PX	202/206	VK3JF	213/221
VK4RF	264/277	VK2AKK	126/128

W.I.A. 52 MHz. W.A.S. AWARD

New Member:

Cert. No.	Call	Add. Count.
103	VK2ADM	3

W.I.A. V.H.F.C.C.

New Member:

Cert. No.	Call	Confirmations 52 MHz.	Confirmations 144 MHz.
84	VK3ZYO	—	106

Amendments:

46	VK3ZNJ	285	—
47	VK3ZNJ	—	210
80	VK4ZIM	649	—

Well known 6 metre DXer, Lyndsay VK4ZIM, who recently confirmed 200 different Japanese cities worked on the 6 metre band. Awards obtained by Lyndsay in recent years on v.h.f. have been the Cook Bi-Centenary Award, VHFCC and WAS. His current total of stations confirmed on 6 metres is 650.

Specimen copy of the Hunter Branch Award Certificate issued by the Hunter Branch (N.S.W. Division, W.I.A.). Rules for the Award will be given in November "A.R." Awards Column

CONTESTS

(Continued from Page 19)

the original idea of a field station and the other to give v.h.f. operators another entry into the competition.

The field station takes much more organising especialy where a lot of people are involved compared with the mobile chap, h.f. or v.h.f., who gets into his car and goes for a drive. (I do both on field days.) So I propose the "Fixed" station division and the "mobile" station division. You may think that a separate contest would be better? Anyhow, let us try it out in 1973 and see how it works.

Definition of a "Fixed Field Station". Transmitters and receivers are to operate from a power supply which is not used in connection with moving a vehicle (who said horsepower?) or which is not connected to any permanent installation. A car battery OUT of the car is acceptable.

"Mobile Field Station". Txs and Rxs are to be installed in a vehicle.

Rules for the "Fixed" stations will be as last year plus a c.w. bonus. "Mobile" stations will be phone only—6 and 24-hour. Both divisions may work v.h.f. with a 2-hour interval as for the R.D. Contest.

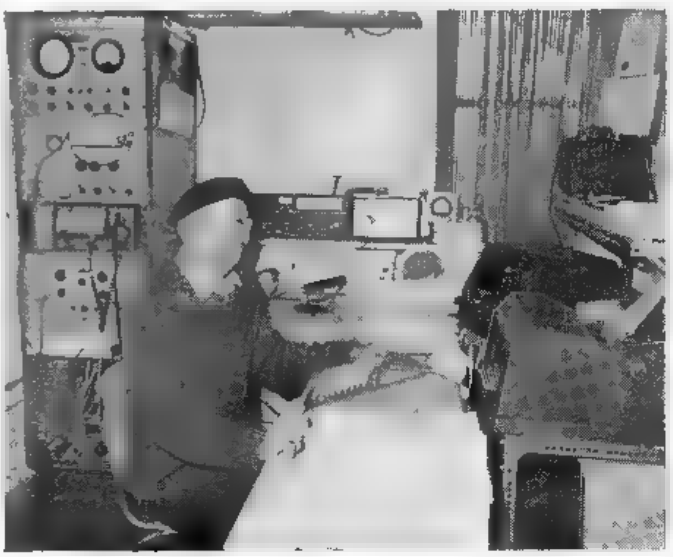
Repeaters may be used. I see no reason why any operator should not enter both divisions provided he calls VK4XX/portable or VK4XX/mobile as the case may be and puts in separate logs. Any comments?

Rules in detail should appear in December "Amateur Radio"

There should be plenty of activity for all h.f., v.h.f., portables and mobiles. If certificates are given to overseas stations for VK portable or mobile contacts we may get some interest from there.

So what about getting yourself, and your friends, well organised for February 10 and 11, the second week-end in February 1973.

Note—If you join in it will be a good contest.



The Federal Contests Manager, Peter Brown, VK4PJ, in his well-equipped shack. However, he has to keep ample table top space free for checking contest logs.

* 7 Norman Avenue, Frankston, Vic., 3199.

you and DX

With Don Grantley*

Times: GMT

Although pressure here has prevented me from even switching the receiver on for many weeks, I think I can manage a few items of interest this month. It would appear that conditions are still quite good and if current reports are anything to go by, then we are in for a good summer.

Hank VK3BHL has been amongst the good stuff over the recent period and has hooked amongst others 7Z3AB, 4X4JU, CR7IZ, EL3CY, XU1AA, EP2SS, UQ2HO, OD5FB, CR7BC, 9G1BF, VP2VAR. My thanks to Hank for taking the trouble to compile a very informative list of log extracts, etc., all of which is a very real help. But, unfortunately, I have misplaced Hank's address, so I cannot thank him by letter.

Note to hand from HB9NL re the proposed jaunt to Leichtenstein. Using the calls HB0NL and HB0AIC, the two operators, HB9NL and HB9AIC, will be QRV from that locality from Oct. 9 to 21 using c.w. and s.s.b. on all bands from 160 to 10 mx daily. Skeds can be made via HB9NL, Frank Acklin, CH8233, Bueron, Switzerland, and any help or questions pertaining to the operation can be had from him or the other operator, Bruno Herger, Wesemlinterrasse 26000 Luzern, Switzerland. QSLs should go direct or via the Bureau and replies will be sent after the operation is completed.

VK3BQQ is off to Lord Howe Is. from Oct. 13 to 19 and will be using 3502, 7002, 14002, 14045, 14110 (n.s.b.), 21045 and 28045, 7045 c.w. will be used for the VK/ZL c.w. section as will 14095, which will also be used for the OK Contest. His address is Box 3909, G.P.O., Sydney, N.S.W., 2001.

Whilst on the subject of special events, please do not forget the Jamboree-on-the-Air, to be held over the week-end of Oct. 21 and 22. Starting time is 0001 local time, and the event will terminate at 2359 local time Sunday 22nd. Rules are simple, advise your branch supervisor of your intention to participate, observe your national licence regulations, use any authorised frequency or mode, and send in a report to your branch supervisor after the event. I mention it as a most worthy event for any interested persons, no amount of praise is high enough for the Scouting movement and it is only fitting that a hobby as great as Amateur Radio should be enlisted to aid and propagate such a worthy cause. I hope to be listening to much of it from a hill top at Imbil in Queensland, overlooking Gympie.

A long and interesting letter to hand from Murray VK4KX, who has taken a lot of trouble to compile a list of stations heard and worked. Amongst the latter were XV3AC, QSL to W1YRC, CMERC Box 5, Santiago de Cuba, Cuba, VK8JW/Mellish Reef, QSL to VK3JW; KZ5BH, SM6AW, Box 357, Labuan, 5X5NK, via DJ3JV, PZ1AH, via Bruo, FH0DL on Comoros Is., QSL to DK2SI, and VU2SFBZ on Pt. Blair Andaman Is., QSL to Bureau. Murray would like to hear from anybody who has the correct QSL information on 9G1DL, his address is 6 Murray St., Red Hill, Brisbane, 4059. I cannot assist with QTHs of more than a month back as all my information sheets, etc., are packed.

At this stage I would like to pause in the notes and comment on a few remarks from VK4KX, who for the past year has been VK4 Intruder Watch Co-ordinator. The old Australian attitude of "She's right, George," may be fine at times, but when we see it applied to our bands it is high time a few more of us started yelling in the right sources. The frequencies allocated to the exclusive use of the Amateur Service are theirs by right, and theirs alone. To the listener who spends much of his spare time monitoring the bands, it is sickening to see these portions of the spectrum being taken by those interests who have absolutely no right whatsoever to them. Repeatedly I have noticed high power Amateur operators change channels or even bands in the middle of a QSO to escape the interference from these parasites who have only their own interests at heart. They can be driven from the bands, I have seen it done by some of our chaps who can be bothered to make the effort.

What has this to do with VK4KX? As one who is keenly interested in these pests, he offers the following suggestions. Take the time and trouble to log their operations and send the information on an official Report Form either to himself or Alf VK2LC for handling by the P.M.G's Department. Secondly, do not avoid the frequency, but call CQ and run QSOs on it wherever possible, in particular he suggests that local QSOs be held on top of these channels and not in the clear spots. Thirdly, more Amateur activity on the air is desperately needed, many bands are deserted for lengthy periods of time, leaving the way open for commercials and pirates to come in.

I would like to add a very timely point of my own to this one, how about those smarties who delight in interfering with other people's operation inflicting their unwanted attention on some of these operators who have no right being on the Amateur bands. This would no doubt give them the pleasure they seek in annoying others and at the same time doing all and sundry a good service—or is not this part of their make-up?

Back to more pleasant things, and I was very pleased to hear from Chas. VK4UC a few days ago and he tells me that four operators including Jerry KZ5JF will be operating from Serrana Bank under the call sign KS4SZ from Oct. 26 to 31 on all phone sections of the U.S.A. band allocations. Jerry holds a general ticket, so when he is on, he will be operating above 14270 and looking for VK/ZL contacts.

Special prefixes reported by Geoff Watts in the past few weeks include 9H4 for special stations operating from Gozo from August 1, several from JY have also cropped up. JY5HC QSL Box 2383 Amman, JY6FC and HA have their QSLs handled by DJ9ZB, JY9GR has DK4PP, JY9VO uses the services of HB9AMO, while JY9TZH goes to his home call K9TZH. Venkat appeared using the call VU2SKV, a special call to celebrate India's 25 years of Independence. His manager is W6KNH. FG6GE operating recently from FS7 was Bob W1VYS who claims to be returning to that locality from January to April of 1973.

Now for a quick run around the Pacific. Firstly, KS4BH currently on from Swan Is., often using 14310 s.s.b., QSL to K3RLY. Clipperton Island is in the news with the declaration by the French Government that they will not allow any further Amateur activity from that location. VR8TC is reported in Auckland for hospital treatment and it is said that he will not return home for some time. VR4EE still active at the time of writing. QRV daily except Friday around 21310 or 21295 from 0900z, his address is Jacques Sapir, Box 400, Honiara, Guadalcanal. KS6CY QSLs for the end of July operation by Jim WB6CZB go to his manager WB5BHN. VR1 British Phoenix will issue future calls in the VP1P series from now on. KB6DA and VR1W operation by W6RHY should be on from mid September to the end of October, with a special interest in 160 metres. All QSLs and sked requests should go to W6CUF. Ken C21TL quite busy on s.s.b., has also been reported on 14040 c.w., QSL to Ken Matchett, Box 32, Nauru, Central Pacific.

Scores have just been released for the 1971 "CQ" DX Contest. Prominent amongst the top scorers were VKs 2XB, 6HD, 5NO and 2APK. The top ten were KH6RS, VR1W, 6D1AA, VP2A, KH6IJ, 3B9CR, HS6ABD, W1FBY, W1BPW and W3WJD.

In a recent poll conducted amongst the world's 200 top DX men, the following countries were named as the most wanted. In order of demand they are FO8, 3Y, VP8 Sth. Sandwich, YI Spratley Is., AC4, XV (poll taken prior to XV5AC ops.), XZ, 7O, 3X, AC3, VR3 Fanning, 7O, KP6 Palmyra Geysar Bank, A8, HK0 Malpelo, VK4 Willis, VK0 Heard Is., CE0Z Juan Fernandez, PY0 St. Peter and Paul Rocks, and HK0 Bajo Nuevo. Others in close proximity to VK which are slightly lower in the list are Manihiki, Tokelau, Kure Is., Niue, Campbell Is., Wallis Is. and Portuguese Timor.

Finally, some changes to the A.R.R.L. list. Minerva Reef to be deleted as from July 15, 1972, now counts as Tonga; Maria Theresa Reef will be deleted from October and all credits for it will be annulled.

My thanks to all who have written this month. I may be a little slow in answering due to impending move of QTH, but I will get around to it. Until notified otherwise, please send all mail to the same address.

REMINDER

Dates for the VK-ZL-Oceania DX Contest are: Phone, 7th and 8th October; c.w., 14th and 15th October, 1972.

* P.O. Box 221, Penrith, N.S.W., 2750.

Ionospheric Predictions

With Bruce Bathols,* VK1ASE OCT. '72

Listed below are predictions for October 1972 from Charts Series "P" supplied by courtesy of the Ionospheric Prediction Service Division.

All times stated are G.M.T.

VK8 is Macquarie Island.

VK4 is Brisbane.

ZL is Auckland.

28, 21 and 14 MHz. predictions are usable for more than 50 per cent. of the month, but not all days.

28 MHz.—

VK1/2	to	W6		minus 2 2400 plus 2
VK3	..	JA		minus 2 0200 plus 2
VK4	..	8Z	L.P.	minus 1 2100 plus 4
VK5	..	KH6		minus 3 0100 plus 3
VK6	..	SU		minus 1 0600 plus 1
ZL	..	W1		minus 3 2300 plus 1

21 MHz.—

VK1/2	to	VE3	S.P.	[illegible]
..	..	VE3	L.P.	2300, 1100
..	..	W6		1900-0400
..	..	PY		minus 6 0400 plus 2 0900
..	..	8Z	S.P	minus 4 0300 plus 1 0600-1100
			L.P.	1900-0300
				0600 plus 5
..	..	G	S.P.	[illegible]
			L.P.	[illegible], 0000
VK3	..	UA		0400-[illegible]
..	..	JA		[illegible]
..	..	F	S.P.	minus 2 0700 plus 5
			L.P.	[illegible]
VK4	..	W1		minus 1 2300 plus 1
..	..	UA		minus 3 0600 plus 9
..	..	PY		minus 5 0100 plus 5
VK5	..	KH6		minus 6 0100 plus 12
VK6	..	SU		minus 3 0600 plus 9
..	..	W1		minus 1 1400 plus 2
..	..	VK9		minus 6 0500 plus 5
ZL	..	G	S.P.	minus 2 1000 plus 4
..	..	ZS		minus 2 0600 plus 3

14 MHz.—

VK1/2	to	VE3	S.P.	1900-2000, 0400
			L.P.	2100-0300, 1500
..	..	W6		1500-2000, 0400-1100
..	..	PY		1900-1400
..	..	VK0		2000-1300
..	..	VK9		2300-1100
..	..	G	S.P.	0700-2000
			L.P.	1900-0300, 0500-1300
VK3	..	UA		0700-1900
..	..	JA		0600-2400
..	..	F	S.P.	0600-0100
			L.P.	0900 plus 7, 2300
VK4	..	8Z	S.P.	1400-0100
			L.P.	0400-1100, 1300-1800
..	..	W1		0600, 1200-2000
..	..	UA		0600-1800
..	..	PY		1000-1200
VK5	..	KH6		0400-1800, 1700-2100
VK6	..	SU		1100-0300
..	..	W1		1300-2400
..	..	VK9		2100-1500
ZL	..	G	S.P.	0600-2000
			L.P.	[illegible]
..	..	ZS		0400-0800, 1100-1400, [illegible]

7 MHz.—

VK1/2	to	VE3	S.P.	0700-1300
			L.P.	2100
..	..	W6		0700-1800
..	..	PY		0800
..	..	VK0		0600-2000
..	..	8Z	S.P.	1700-2100
			L.P.	0700
..	..	G	S.P.	1500-2100
			L.P	0800
VK3	..	UA		1300-2100
..	..	F	S.P.	[illegible] 2100
			L.P.	0800
VK4	..	8Z		1800-2000
..	..	W1		0700-1300
..	..	UA		1200-2000
..	..	PY		0800
VK5	..	KH6		0800-1700
VK6	..	SU		1500-2200
..	..	VK9		1000-2100
ZL	..	G	S.P.	0700, 1800-1900

Smoothed Monthly Sunspot numbers predictions for September 85, October 89, November 91, December 40.

—Swiss Federal Observatory, Zurich.

* 3 Connewarra Ave., Aspendale, 3195.

NEW CALL SIGNS

JUNE 1972

VK1ZRH—R. G. Henderson, 53 Hannaford St., Page, 2614.
VK2AHC—D. Clift, 6 Gilles Cres., Dee Why, 2099.
VK2AUS—K. C. Smith, Flat 13, Telford Gardens, 29 Cottonwood Cres., Marsfield, 2122.
VK3BTG—R. C. McGregor, 44 Koola Ave., Killara, 2071
VK2CAX—K. C. McCracken, 8 Kelburn Rd., Roseville, 2069.
VK2BCA—A. N. Cherry, 1/1 Denison St., Manly, 2095.
VK2BIF—I. Forrest, 32 Victoria St., Epping, 2121.
VK2BIM—L. A. Adams, 13 Frederick St., North Bondi, 2026
VK2BIO—W. A. A. Brown, 3 Bedford Pl., Rockdale, 2216
VK2BJK—K. J. Blume, 57 Wyomee Ave., West Pymble, 2073.
VK2BLI—D. R. Nagle, 8/445 Glebe Pt. Rd., Glebe, 2037.
VK2BRD—R. F. Drummond, 2 Shepherd St., Goulburn, 2580.
VK2BTC—C. T. Rylatt, Lot 1089, Kooloona Cres., Campbelltown, 2560.
VK2ZDJ—D. J. McWilliam, 22/235 Victoria Ave., Chatswood, 2067
VK2ZOX—A. W. Sweetnam, 35 Nerim Rd., Castle Cove, 2[illegible]
VK2ZVF—B. W. Pratt, 70 Auburn Rd., Birrong, 2143.
VK2ZXE—M. R. Beery, 135 Marsh St., Armidale, 2350.
VK2ZXF—J. H. Melvin, 7 French St., Kingswood, 2750.
VK2ZXI—A. S. Wollin, 3 Kinsey St., Moama, 2739.
VK2ZXJ—L. E. Benger, 75A Wattle Rd., Jannali, 2226.
VK2ZXK—T. R. B. Allan, 6 Phyllis St., Mt. Pritchard, 2170.
VK2ZXN—E. Klem, 48 Harriet St., Waratah, 2298.
VK2ZXO—P. Z. Hadwen, 40 Quintana Ave., Baulkham Hills, 2153.
VK2ZXQ—J. H. Tanner, 57 Rawson Rd., Woy Woy, 2256.
VK2ZXS—J. McPherson, 33 Watt St., Raymond Terrace, 2324.
VK2ZYN/T—B. W. Clark, 21 Erwin St., Tamworth, 2340.

SILENT KEYS

It is with deep regret that we record the passing of—

VK2SB—R. W. Chaplin
VK4IM—J. D. MacLean
VK5CK—R. V. Lapidge
VK6HI—E. A. Hayward

VK2ZYO—N. C. Chivers, 51 Meeks Cres., Faulconbridge, 2776.
VK2BBV—L. R. Burston, 4 Hillside Cres., Glenbrook, 2773.
VK2ZXA—J. Mowatt, 8/31 Cornelia St., Punchbowl, 2196.
VK2ZUS—G. W. Francis, 53 Falconer St., West Ryde, 2114.
VK3CA—G. D. Whiter, 36 Simmons St., Box Hill, 3129.
VK3CH—I. R. Ampt, 4 Ranleigh Rise, Lower Templestowe, 3107.
VK3KK—R. F. Lloyd, 171 Cheddar Rd., West Keon Park, 3073.
VK3VE—M. G. White, 62 Peter St., Box Hill North, 3129.
VK3CDS—K. Sutcliffe, 66 Savige St., Morwell, 3694.
VK3YGK—P. J. Bassett, 23 Wilson St., Woodonga, 3690.
VK3ZRG—R. J. Bocks, 4 Doona Ave., Kew, 3101.
VK3BGD—J. W. Williamson, 30 Latona Ave., Knoxfield, 3180.
VK4ED—R. J. Thomson, Station: Bli Bli, via Nambour; Postal: P.S. 1505, Nambour, 4560.
VK4ZAK—F. F. Adamson, 7 Gordon Ave., Toowoomba, 4350.
VK4ZAN—A. J. MacKenzie, 4 Laird St., Mackay, 4740.
VK4ZAP/T—E. J. Smith, 3/38 Bayswater Tce., Townsville, 4810.
VK4ZIV—I. K. R. Vosper, 17 Belvedere St., Holland Park West, 4121.
VK4ZML—G. P. Lee-Manwar, 44 Webb St., Stafford, 4053.
VK5AN—J. W. Emmel, P.O. Box 382, Port [illegible]e, 5015.
VK5AW—A. C. Wallace, 23 Edgeworth St., Prospect, 5082.
VK5UM—A. E. Taylor, Officers' Mess, R.A.A.F. [illegible], Edinburgh, 5111.
VK5ZAQ—D. B. Adlam, 32 School Dr., Banksia Park, 5191.
VK5ZBF—P. G. Becker, 51 Boandik Tce., Mt. Gambier, 5290.
VK5ZBQ—B. R. Williams, 45 Finnis Ave., Ingle Farm, [illegible]
VK5ZCW—P. M. Cottell, 71 Wireless Rd., Mt. Gambier, 5290.
VK5ZMF—T. J. McCarthy, 2 Warwick St., Enfield, 5085.
VK5ZPW—P. J. Wegener, P.O. Box 125, Angaston, 5353.
VK6BZ—R. R. Braun, Station: 67 Omdurman St., Wagin; Postal: 50 Ventnor St., Wagin, 6315.
VK6OW—O. J. Willoughby, 48 View Tce., East Fremantle, 6158.
VK6RR—R. K. Green, 14 Doust St., Cannington, 6107.
VK6SD—J. R. Dupont, Flat 18, Robertson Crt., 185 Wanneroo Rd., Tuart Hill, 6060.
VK6WC—J. W. Coultham, 4 Kimbrace Way, Lynwood, 6155.
VK6ZEM—E. M. Norris, Station: 24 Ranger Rd., Mt. Yokine, 6060; Postal: C/o. O.T.C., P.O. Box 21, Balga, 6061.
VK6ZHG—R. R. Gillis, 20 Stewart St., Albany, [illegible]
VK8ZCB—T. P. Walters, Base Radio, R.A.A.F., Darwin, 5793.
VK9GO—R. S. Goldsworthy, P.O. Box 28, Panguna, Bougainville.

LICENSED AMATEURS IN VK

JUNE 1972

	Full	Lim.	Total	
VK0	6	1	7	
VK1	91	28	119	
VK2	1286	541	1827	
VK3	1319	670	1989	
VK4	530	209	739	
VK5	514	220	734	
VK6	368	136	504	
VK7	153	66	219	
VK8	35	12	47	
VK9	90	14	104	
	4502	1897	6399	Grand Total

KEY SECTION

With Deane Blackman,* VK3TX

As I have been overseas this past month I have not had time to collect materia. for this month's column. So let me bring you up to date with new members:

14. VK4FJ	25. VK9BJ	32. VK4SS
15. VK4SO	26. VK4OD	33. VK4EZ
16. VK4KK	27. VK4RE	34. VK4VO
18 VK4CA	28. VK4RF	35. VK3RJ
22. VK3AAC	29. VK4UG	36. VK6RL
23. VK6RB	30. VK4NV	37. VK3BZ
24. VK4TH	31. VK4QS	38. VK3ABR

Applications received after August will appear in a later list.

For ease of reference, the Divisional co-ordinators of the Key Section are: VK2YE, VK3XB, VK4DP, VK5FM, VK6WT, VK7LJ. If you have any ideas for the Section they would be happy to discuss them with you.

* 44 Rathmullen Rd., Boronia, Vic., 3155.

HAMADS

- **A free service for individual members.**
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- **Excludes commercial-class advertising.**
- **Exceptions only by PRIOR arrangement.**

For full details see January 1972 "A.R." page 23.

FOR SALE

Melbourne, Vic.: Type RC1A A.W.A. Control Unit for remote contro of A.W.A. Base Unit, complete with circuit, good condition, $25. VK3ZMR, Phone 306-7538

Caulfield, Vic.: "Radio Communication" 1967-1972 20c. "Wireless Wor d 1954-1965 10c, "QST" 1928-1965, 10c, "Practical Electronics" 1964-1967, 10c; some full years. VK3WO, QTHR, Ph. 211-5199.

Footscray West, Vic.: 16AVQ Antenna. 40 through 10 mx. good order, with assembly instruct one, $20. VK3ZM, QTHR, Ph. (03) 689-3135 (AH).

Bendigo, Vic.: SSB 160-10 mx, 180w PEP G2DAF Tx; VFO plus or minus 250 kHz.; Edd. 898 Dia., U/L SB, VOX, Bk-in, sep. HD PSU, xtl. m ke, professionally constructed/aligned, proven DXer, $120 o.n.o., genuine sale. Birch, VK3ASO QTHR, Ph. (054) 43-1877

Melbourne, Vic.: 160 mx Mobile Transceiver, 20 watt output; SSB Transceiver PSU, 240 vo t AC Lafayette Grid Dip Meter; RF Ammeter, 2 amp. FSD, co-axial mounting VK3BR, QTHR, Ph. (03) 89-5321 Ext. 2257

Melbourne, Vic.: Yaesu FLDX400 Tx, $250. Will also sell FRDX400 Rx if transceiver required. VK3AIF QTHR, Ph. (03) 947-5401

Woomera, S.A.: FT200 Transceiver with FP200 P.S.U. only three months use, $380. Semi automatic Bug Key, $8. Postage extra. VK5WC, QTHR

Melbourne, Vic.: Te escopic Tower, 4 x 25 foot sections, galvanised, built-in winch and cable, $60. VK3JT, Ph. (03) 314-6780

WANTED

Sydney, N.S.W.: Linear Amp. FL2000B or FL2500. VK2BC, P.O. Box 111, Kingsford, N.S.W., Phone 38-2385.

Benalla, Vic.: Type 210 Valve. Required for early transmitter project. VK3PF, QTHR

Brisbane, Qld.: Morse Keys, any type, age or condition. Price, particulars to A. Shawsmith, VK4SS, QTHR, Ph. (072) 44-8525.

Melbourne, Vic.: "Amateur Radio" complete volumes 1950 and earlier. To complete my files. Top price paid. Ron Fisher, VK3OM, QTHR Ph. (03) 560-9215.

Ocean Grove, Vic.: A.W.A. 8C Receiver and Coil Boxes. VK3ZNZ, Box 32, Ocean Grove, Vic., 3226.

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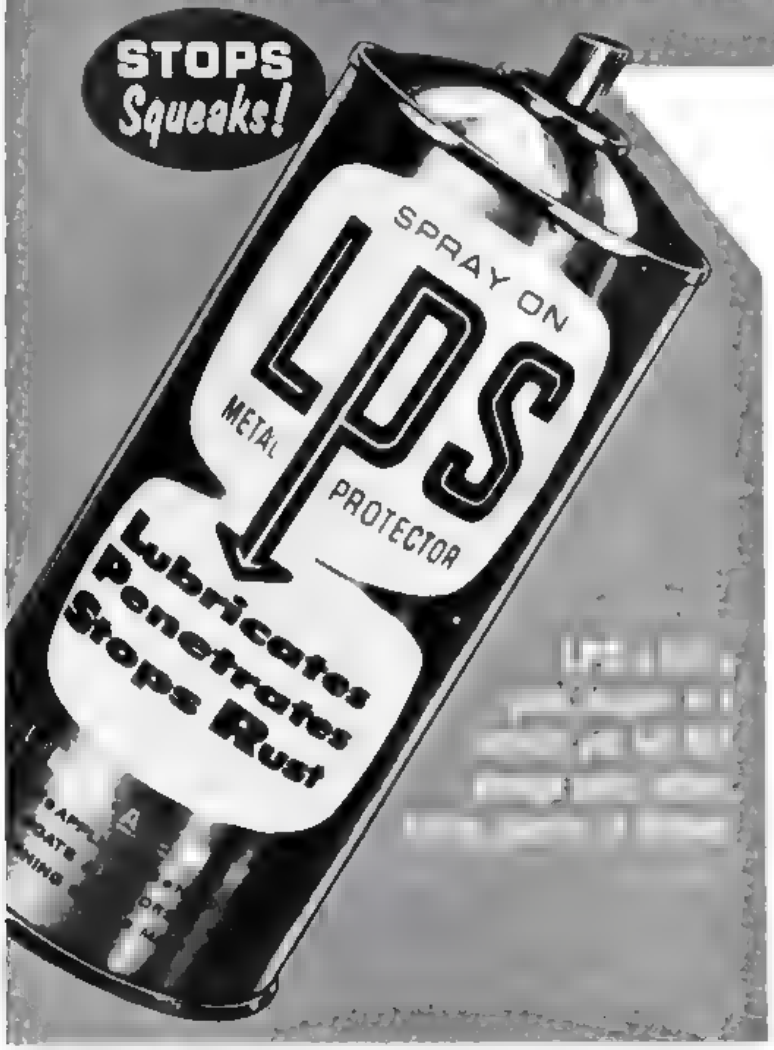

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Less than 0.0001 inch non-greasy molecular film with capillary action that spreads evenly and easily to seal out moisture at very low cost.

Rust Inhibitor: Protects **all** metals from rust and corrosion.

Water Displacing Compound: Dries out mechanical and electrical systems fast.

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Penetrant: Penetrates to loosen frozen parts in seconds.

Volume Resistivity per ASTM D-257: Room temperature, ohm/cm.; 1.04×10^{15}.

Dielectric Constant per ASTM-877:
Dielectric Constant 2.11, Dissipation Factor: 0.02.

Dielectric Strength per ASTM D-150:
Breakdown Voltage 0.1 inch gap, 32,000 volts.
Dielectric Strength volts/inch, 320,000 volts.

Flash Point (Dried Film), 900 degrees F.
Fire Point (Dried Film), 900 degrees F.

TESTS AND RESULTS: 950 degrees F.

Lawrence Hydrogen Embrittlement Test for Safety on High Tensile Strength Steels: Passed. Certified safe within limits of Douglas Service Bulletin 13-1 and Boeing D6 17487.

Mil. Spec. C-16173 D-Grade 3, Passed.
Mil. Spec. C-23411, Passed.

Swiss Federal Government Testing Authority for Industry: Passed 7-Day Rust Test for acid and salt water. Passed Welland Machine Test for Lubricity as being superior to mineral oil plus additives.

LPS Products conform to Federal Mil. Specs. C-23411 and/or C-161730

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WIRELESS INSTITUTE OF AUSTRALIA

PROJECT AUSTRALIS

STANDARD ORBITS — OSCAR 6

This set of Standard Orbits and the Ascending Nodes (the longitude in degrees West and the time in hours, minutes and seconds, G.M.T., of the satellite's path over the Earth, when it crosses the Equator, travelling into the Northern Hemisphere) is the only information needed to track OSCAR 6. It also allows calculation of when the satellite will be in range of the areas around other State capitals.

The morning (Southbound, at around 0900, local time) orbits over Australia have Ascending Nodes between 80 and 290 degrees West, while the evening (Northbound, at 2100 local time) orbits have Ascending Nodes between 150 and 275 degrees West. As a guide, the morning orbits will have smaller numbers at the start of the "ASCN NODE ADD MINS" column (between 56 and 82 minutes), than the evening orbits (between 86 and 104 minutes).

Ascending Nodes will be transmitted in Morse Code by the Codestore system on OSCAR 6 (29.45 and 435.1 MHz), and will also be announced on the weekly Divisional broadcasts.

If you are in or near Sydney, and want to track a (morning) orbit which has an ascendin node of 359 degrees West at 2157 G.M.T., select the closest Standard Orbit from the Sydney set — 360 degrees West. Add 58 minutes to 2157 G.M.T., and you will hear the satellite at 2255 G.M.T. Time, azimuth and elevation points are given every two minutes on the Standard Orbits.

Because the satellite is in an almost circular (1460Km), near-polar orbit, with each orbit being completed in 115 minutes, given one Acending Node (say, 330 degrees West at 1905 G.M.T.), later Ascending Nodes can be determined by simply adding the distance in degrees which separates the orbits at the Equator (the Nodal Increment, 28.8 degrees), to 330, and adding 115 minutes to 1095 G.M.T. The result is, in round figures, 359 degrees West at 2157 G.M.T., for the next orbit.

To see whether the orbit which you are tracking in Sydney will be in range of Perth, look at the Perth Standard Orbit which corresponds with the orbit that you are following. If you are tracking an orbit with an Ascending Node of 359 degrees West and are using the 360 degrees West Standard Orbit for Sydney, OSCAR 6 will be in range of Sydney from 58 to 78 minutes after the Ascending Node (2255 to 2315 G.M.T., on the example above), a total of 20 minutes. The same orbit will be in range of Perth from 68 to 78 minutes after the Ascending Node (2305 to 2315 G.M.T.). Therefore, that orbit will be in range of both Sydney and Perth from 2305 to 2315 G.M.T., so that 10 minutes of contact through the satellite will be possible. By slecting an orbit that passes midway between Sydney and Perth (e.g., an Ascending Node of 25 degrees West), contacts of up to 18 minutes are possible. For contact with New Zealand, orbits to the East of Australia should be used, while for contacts into Asia, orbits in the North and West should be used.

Users of Standard Orbits should note that the sets of Southbound Orbits start towards the end of the set (315 degrees West for Sydney) and resume at the beginning of each set (0 degrees West for Sydney), ending near the middle of the set (45 degrees West for Sydney). They are then immediately followed by the first of the Northbound orbits (150 degrees West for Sydney). It was not possible in the short time available after the OSCAR 6 launch rocket was changed to put the Southbound orbits in continuous order).

Assuming a launch at 1715 G.M.T., on 9th, October, the first Ascending Nodes bringing orbits in range of Australia will be: —

Orbit 1 324 W at 1842 GMT 9/10/72 Southbound
Orbit 2 353 W at 2037 GMT 9/10/72 Southbound
Orbit 3 22 W at 2232 GMT 9/10/72 Southbound
Orbit 4 50 W at 0028 GMT 10/10/72 Southbound
Orbit 8 166 W at 0809 GMT 10/10/72 Northbound
Orbit 9 194 W at 1004 GMT 1/10/72 Northbound
Orbit 223 W at 1159 GMT 10/10/72 Northbound
Orbit 252 W at 1354 GMT 10/10/72 Northbound

Any change in the OSCAR 6 launch date will alter the times, but not the longitudes of the Ascending Nodes. Any alterations will be notified on Divisional broadcasts.

INSERT WITH AMATEUR RADIO OCTOBER 1972

PERTH

ASCN NODE 1. W.			ASCN NODE 5. W.			ASCN NODE 19. W.			ASCN NODE 15. W.			ASCN NODE 20. W.			ASCN NODE 25. N.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
68.8	162	4	64.8	162	4	64.8	162	4	67.8	96	0	68.8	97	4	64.8	17	4
72.8	155	4	68.8	161	4	66.8	87	4	66.8	73	4	62.8	58	4	62.8	52	11
74.8	148	4	70.8	153	4	64.8	78	4	64.8	65	4	64.8	49	4	64.8	45	11
76.8	138	4	72.8	127	10	70.8	114	15	68.8	99	18	66.8	88	20	66.8	75	20
78.8	121	4	74.8	110	10	72.8	116	21	70.8	84	26	68.8	78	26	68.8	67	30
78.8	161	2	76.8	134	7	74.8	146	33	72.8	135	26	70.8	128	28	70.8	127	37
			78.8	165	4	76.8	154	41	74.8	152	36	72.8	152	31	72.8	152	41
						78.8	169	5	76.8	164	41	74.8	159	39	74.8	167	21
						80.8	171	4	78.8	171	4	76.8	165	41	76.8	171	4
						82.8	172	4	80.8	178	4	78.8	171	4			
												80.8	176	4			

ASCN NODE 39. W.			ASCN NODE 35. W.			ASCN NODE 40. W.			ASCN NODE 45. W.			ASCN NODE 50. W.			ASCN NODE 55. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
58.8	36	4	58.8	36	4	58.8	36	4	58.8	36	4	58.8	36	4	58.8	36	4
60.8	39	7	60.8	39	10	60.8	39	13	60.8	A 14	5	58.8	360	4	60.8	345	13
62.8	44	15	62.8	43	17	62.8	43	19	62.8	43	20	60.8	355	4	62.8	334	21
64.8	52	26	64.8	50	32	64.8	50	34	64.8	50	34	62.8	347	48	64.8	320	30
66.8	62	28	66.8	61	36	66.8	61	38	66.8	61	38	64.8	343	34	66.8	310	36
68.8	97	90	68.8	180	90	68.8	175	86	68.8	259	68	66.8	339	49	68.8	303	36
70.8	134	47	70.8	134	49	70.8	134	49	70.8	134	49	68.8	267	16	70.8	243	29
72.8	149	35	72.8	151	36	72.8	151	36	72.8	151	36	70.8	243	38	72.8	225	26
74.8	177	103	74.8	177	103	74.8	177	103	74.8	177	103	72.8	225	26	74.8	216	12
76.8	184	13	76.8	190	12	76.8	190	11	76.8	202	9	74.8	211	15	76.8	210	9
78.8	192	7	78.8	223	5	78.8	223	5	78.8	223	5	76.8	223	5			
			78.8	214	7							78.8	223	5			

ASCN NODE 60. W.			ASCN NODE 65. N.			ASCN NODE 70. W.			ASCN NODE 75. W.			ASCN NODE 185. N.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
58.8	348	4	58.8	332	4	58.8	324	4	62.8	294	4	58.8	36	4
60.8	332	11	62.8	323	8	60.8	319	9	64.8	297	4	60.8	39	7
62.8	321	17	64.8	311	13	62.8	315	13	66.8	285	4	62.8	44	15
64.8	308	24	66.8	297	17	64.8	298	11	68.8	272	7	64.8	52	26
66.8	285	27	68.8	273	19	66.8	277	7	70.8	247	8	66.8	62	28
68.8	262	26	68.8	262	18	68.8	262	12	70.8	247	5	68.8	97	90
70.8	244	21	70.8	248	15	70.8	247	9	72.8	236	5	70.8	134	47
72.8	230	19	72.8	233	10	72.8	235	6				72.8	149	35
74.8	223	5	74.8	223	5	74.8	223	5				74.8	177	103
76.8	213	2	76.8	214	7							76.8	184	13
												78.8	192	7

ASCN NODE 180. W.			ASCN NODE 200. W.			ASCN NODE 205. W.			ASCN NODE 210. W.			ASCN NODE 215. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
88.8	125	4	94.8	128	4	96.8	147	0	96.8	158	2	96.8	153	2
102.8	115	3	100.8	124	8	98.8	140	4	98.8	144	9	98.8	146	12
104.8	108	12	102.8	118	12	100.8	132	10	100.8	135	15	100.8	137	19
106.8	91	6	104.8	102	15	102.8	116	18	102.8	122	25	102.8	128	33
108.8	70	0	106.8	85	16	104.8	101	23	104.8	102	32	104.8	110	43
110.8	68	3	108.8	74	18	106.8	86	25	106.8	85	39	106.8	85	47
112.8	56	4	110.8	63	18	108.8	70	23	108.8	69	43	108.8	67	49
			112.8	49	9	110.8	44	17	110.8	53	32	110.8	58	25
			114.8	29	9	112.8	29	9	112.8	14	7	112.8	9	7
						114.8	24	4	114.8	24	4	114.8	24	4

ASCN NODE 224. W.			ASCN NODE 225. W.			ASCN NODE 230. W.			ASCN NODE 235. W.			ASCN NODE 240. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
88.8	194	7	88.8	194	7	88.8	194	7	88.8	194	7	88.8	194	7
90.8	198	7	90.8	162	9	90.8	166	16	90.8	171	11	90.8	188	15
92.8	194	7	92.8	161	7	92.8	164	7	92.8	169	12	92.8	184	7
94.8	189	27	94.8	158	11	94.8	161	11	94.8	168	13	94.8	180	11
96.8	183	44	96.8	154	15	96.8	157	15	96.8	166	15	96.8	175	15
98.8	175	54	98.8	147	18	98.8	150	18	98.8	161	16	98.8	169	16
100.8	165	64	100.8	137	20	100.8	141	20	100.8	153	18	100.8	161	18
102.8	149	72	102.8	123	23	102.8	129	23	102.8	142	21	102.8	150	21
104.8	127	76	104.8	104	27	104.8	112	27	104.8	127	25	104.8	136	25
106.8	98	74	106.8	78	30	106.8	89	30	106.8	107	29	106.8	118	29
108.8	69	64	108.8	53	30	108.8	63	30	108.8	84	30	108.8	96	30
110.8	43	46	110.8	31	25	110.8	39	25	110.8	59	25	110.8	72	25
112.8	24	20	112.8	16	13	112.8	20	13	112.8	34	13	112.8	46	13
114.8	14	4	114.8	9	4	114.8	14	4	114.8	24	4	114.8	34	4

ASCN NODE 244. W.			ASCN NODE 245. W.			ASCN NODE 250. W.			ASCN NODE 255. W.			ASCN NODE 260. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
88.8	194	7	88.8	194	7	88.8	194	7	88.8	194	7	88.8	194	7
90.8	198	7	90.8	198	7	90.8	198	7	90.8	198	7	90.8	198	7
92.8	194	7	92.8	194	7	92.8	194	7	92.8	194	7	92.8	194	7
94.8	189	27	94.8	189	27	94.8	189	27	94.8	189	27	94.8	189	27
96.8	183	44	96.8	183	44	96.8	183	44	96.8	183	44	96.8	183	44
98.8	175	54	98.8	175	54	98.8	175	54	98.8	175	54	98.8	175	54
100.8	165	64	100.8	165	64	100.8	165	64	100.8	165	64	100.8	165	64
102.8	149	72	102.8	149	72	102.8	149	72	102.8	149	72	102.8	149	72
104.8	127	76	104.8	127	76	104.8	127	76	104.8	127	76	104.8	127	76
106.8	98	74	106.8	98	74	106.8	98	74	106.8	98	74	106.8	98	74
108.8	69	64	108.8	69	64	108.8	69	64	108.8	69	64	108.8	69	64
110.8	43	46	110.8	43	46	110.8	43	46	110.8	43	46	110.8	43	46
112.8	24	20	112.8	24	20	112.8	24	20	112.8	24	20	112.8	24	20
114.8	14	4	114.8	14	4	114.8	14	4	114.8	14	4	114.8	14	4

ASCN NODE 264. W.			ASCN NODE 265. W.			ASCN NODE 268. W.			ASCN NODE 8. W.			ASCN NODE 9. W.			ASCN NODE 3. N.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
74.8	134	4	74.8	134	4	74.8	134	4	74.8	122	2	74.8	122	2	74.8	122	2
76.8	145	9	76.8	134	7	76.8	134	7	76.8	134	7	76.8	134	7	76.8	134	7
			78.8	136	2	78.8	136	2	78.8	136	2	78.8	136	2	78.8	136	2
			78.8	147	2	78.8	147	2	78.8	147	2	78.8	147	2	78.8	147	2
			78.8	156	2	78.8	156	2	78.8	156	2	78.8	156	2	78.8	156	2
						78.8	165	2									

BRISBANE

ASCN NODE 1. W.			ASCN NODE 5. W.			ASCN NODE 18. W.			ASCN NODE 15. W.			ASCN NODE 20. W.			ASCN NODE 25. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
54.8	1	4	54.8	1	4	54.8	1	4	54.8	1	4	54.8	1	4	54.8	1	4
56.8	26	4	56.8	16	10	56.8	9	12	56.8	5	12	56.8	352	11	56.8	342	12
58.8	29	17	58.8	15	28	58.8	7	36	58.8	1	36	58.8	350	36	58.8	333	36
62.8	32	24	62.8	14	34	62.8	353	39	62.8	334	41	62.8	334	41	62.8	314	41
64.8	34	27	64.8	14	36	64.8	353	41	64.8	333	43	64.8	333	43	64.8	297	32
66.8	79	69	66.8	334	43	66.8	281	44	66.8	274	46	66.8	274	46	66.8	271	33
68.8	168	83	68.8	285	84	68.8	252	76	68.8	252	76	68.8	252	76	68.8	248	28
70.8	181	41	70.8	246	39	70.8	215	33	70.8	199	29	70.8	197	21	70.8	222	23
72.8	177	21	72.8	215	16	72.8	202	15	72.8	192	15	72.8	192	15	72.8	202	15
74.8	198	15	74.8	198	13	74.8	198	13	74.8	178	8	74.8	178	8	74.8	214	5
76.8	214	5	76.8	214	5	76.8	214	5	76.8	214	5	76.8	214	5			
												78.8	224	2			

ASCN NODE 39. W.			ASCN NODE 35. W.			ASCN NODE 40. W.			ASCN NODE 45. W.			ASCN NODE 158. W.			ASCN NODE 155. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
54.8	331	4	54.8	315	2	58.8	315	2	58.8	299	1	84.8	273	4	104.8	158	2
56.8	327	4	56.8	315	2	60.8	315	2	60.8	299	1				102.8	151	2
58.8	312	10	62.8	295	8	64.8	276	4	64.8	276	4				100.8	144	2
60.8	295	16	64.8	276	4	66.8	276	4	66.8	276	4				98.8	136	2
64.8	262	16	66.8	255	9	68.8	252	8	68.8	252	8				96.8	129	2
66.8	247	16	68.8	252	8	70.8	241	3	70.8	241	3				94.8	122	2
68.8	232	13	70.8	248	4												
72.8	228	4	72.8	228	4												
74.8	224	4															

ASCN NODE 160. W.			ASCN NODE 165. W.			ASCN NODE 170. W.			ASCN NODE 175. W.			ASCN NODE 180. W.			ASCN NODE 185. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
100.8	133	3	98.8	145	1	98.8	167	4	98.8	185	8	98.8	195	8	98.8	163	3
104.8	117	2	100.8	131	2	100.8	151	2	100.8	169	2	100.8	179	2	100.8	147	2
106.8	111	12	102.8	126	12	102.8	138	16	102.8	154	18	102.8	165	18	102.8	150	18
108.8	104	15	104.8	122	14	104.8	135	14	104.8	151	14	104.8	161	14	104.8	151	14
110.8	84	15	106.8	95	22	106.8	94	31	106.8	94	31	106.8	120	34	106.8	122	34
112.8	61	13	108.8	77	19	108.8	77	19	108.8	77	19	108.8	92	19	108.8	91	19
114.8	41	10	110.8	57	19	110.8	46	26	110.8	46	26	110.8	57	42	110.8	36	34
116.8	24	7	112.8	39	14	112.8	29	14	112.8	29	14	112.8	29	14	112.8	29	14
118.8	11	4	114.8	21	9	114.8	21	9	114.8	21	9	114.8	21	9	114.8	357	12
			116.8	4	4										116.8	344	9

ASCN NODE 190. W.			ASCN NODE 195. W.			ASCN NODE 200. W.			ASCN NODE 205. W.			ASCN NODE 210. W.			ASCN NODE 215. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
90.8	168	13	90.8	176	14	90.8	178	6	90.8	183	6	90.8	186	1	90.8	182	1
92.8	162	13	92.8	176	14	92.8	178	6	92.8	183	6	92.8	186	1	92.8	182	1
102.8	175	38	102.8	193	37	102.8	193	33	102.8	193	33	102.8	193	33	102.8	193	33
104.8	172	38	104.8	189	37	104.8	189	33	104.8	189	33	104.8	189	33	104.8	189	33
106.8	165	38	106.8	183	37	106.8	183	33	106.8	183	33	106.8	183	33	106.8	183	33
108.8	156	38	108.8	174	37	108.8	174	33	108.8	174	33	108.8	174	33	108.8	174	33
110.8	144	38	110.8	162	37	110.8	162	33	110.8	162	33	110.8	162	33	110.8	162	33
112.8	129	38	112.8	147	37	112.8	147	33	112.8	147	33	112.8	147	33	112.8	147	33
114.8	107	38	114.8	125	37	114.8	125	33	114.8	125	33	114.8	125	33	114.8	125	33
116.8	77	38	116.8	95	37	116.8	95	33	116.8	95	33	116.8	95	33	116.8	95	33
118.8	39	38	118.8	57	37	118.8	57	33	118.8	57	33	118.8	57	33	118.8	57	33
120.8	357	38	120.8	15	37	120.8	15	33	120.8	15	33	120.8	15	33	120.8	15	33

ASCN NODE 220. W.			ASCN NODE 225. W.			ASCN NODE 230. W.			ASCN NODE 235. W.			ASCN NODE 240. W.			ASCN NODE 245. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
90.8	196	3	90.8	202	2	90.8	206	8	90.8	219	1	90.8	219	1	90.8	96	6
92.8	191	3	92.8	171	11	92.8	186	12	92.8	208	15	92.8	219	1	92.8	96	6
102.8	222	9	102.8	229	5	102.8	228	2	102.8	228	2	102.8	228	2	102.8	96	6
104.8	222	9	104.8	229	5	104.8	228	2	104.8	228	2	104.8	228	2	104.8	96	6
106.8	222	9	106.8	229	5	106.8	228	2	106.8	228	2	106.8	228	2	106.8	96	6
108.8	222	9	108.8	229	5	108.8	228	2	108.8	228	2	108.8	228	2	108.8	96	6
110.8	222	9	110.8	229	5	110.8	228	2	110.8	228	2	110.8	228	2	110.8	96	6
112.8	222	9	112.8	229	5	112.8	228	2	112.8	228	2	112.8	228	2	112.8	96	6
114.8	222	9	114.8	229	5	114.8	228	2	114.8	228	2	114.8	228	2	114.8	96	6

ASCN NODE 260. W.			ASCN NODE 265. W.			ASCN NODE 270. W.			ASCN NODE 275. W.			ASCN NODE 280. W.			ASCN NODE 285. W.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
90.8	96	6	90.8	96	6	90.8	96	6	90.8	96	6	90.8	96	6	90.8	96	6
92.8	96	6	92.8	96	6	92.8	96	6	92.8	96	6	92.8	96	6	92.8	96	6
102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6
104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6
106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6
108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6
110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6
112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6
114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6

ASCN NODE 264. W.			ASCN NODE 265. W.			ASCN NODE 268. W.			ASCN NODE 8. W.			ASCN NODE 9. W.			ASCN NODE 3. N.		
AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL	AGD MINS	AZ	EL
74.8	96	6	74.8	96	6	74.8	96	6	74.8	96	6	74.8	96	6	74.8	96	6
76.8	96	6	76.8	96	6	76.8	96	6	76.8	96	6	76.8	96	6	76.8	96	6
102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6	102.8	96	6
104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6	104.8	96	6
106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6	106.8	96	6
108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6	108.8	96	6
110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6	110.8	96	6
112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6	112.8	96	6
114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6	114.8	96	6

ADELAIDE

ASCN NODE 0. W.

ADD MINS	AZ	EL
60.0	46	8
62.0	51	7
64.0	58	14
66.0	58	23
68.0	85	32
70.0	112	38
72.0	151	35
74.0	162	26
76.0	174	17
78.0	181	9
80.0	186	2

ASCN NODE 5. W.

ADD MINS	AZ	EL
60.0	39	3
62.0	43	11
64.0	49	20
66.0	59	31
68.0	88	44
70.0	119	56
72.0	154	41
74.0	172	28
76.0	181	15
78.0	186	9
80.0	190	2

ASCN NODE 10. W.

ADD MINS	AZ	EL
61.0	31	8
62.0	33	15
64.0	37	25
66.0	46	48
68.0	78	55
70.0	138	64
72.0	173	49
74.0	184	29
76.0	189	17
78.0	191	8
80.0	195	1

ASCN NODE 15. W.

ADD MINS	AZ	EL
58.0	21	1
60.0	21	8
62.0	21	17
64.0	22	29
66.0	25	40
68.0	35	75
70.0	187	70
72.0	196	46
74.0	198	27
76.0	195	16
78.0	195	7
80.0	196	0

ASCN NODE 20. W.

ADD MINS	AZ	EL
58.0	12	3
60.0	11	10
62.0	8	19
64.0	4	32
66.0	355	50
68.0	311	72
70.0	228	61
72.0	211	39
74.0	205	24
76.0	202	14
78.0	200	5

ASCN NODE 25. W.

ADD MINS	AZ	EL
58.0	3	3
60.0	360	10
62.0	355	19
64.0	346	31
66.0	327	45
68.0	287	55
70.0	243	47
72.0	223	33
74.0	213	20
76.0	207	11
78.0	203	4

ASCN NODE 30. W.

ADD MINS	AZ	EL
58.0	354	3
60.0	349	10
62.0	341	18
64.0	329	27
66.0	319	37
68.0	274	41
70.0	249	36
72.0	231	26
74.0	219	16
76.0	211	9
78.0	206	2

ASCN NODE 35. W.

ADD MINS	AZ	EL
58.0	348	2
60.0	339	8
62.0	330	15
64.0	316	22
66.0	297	28
68.0	274	31
70.0	251	26
72.0	236	21
74.0	223	12
76.0	215	6
78.0	209	1

ASCN NODE 40. W.

ADD MINS	AZ	EL
58.0	337	4
60.0	329	6
62.0	319	11
64.0	306	17
66.0	289	21
68.0	270	21
70.0	252	19
72.0	237	14
74.0	226	9
76.0	217	3

ASCN NODE 45. W.

ADD MINS	AZ	EL
60.0	321	3
62.0	311	8
64.0	298	12
66.0	284	14
68.0	268	15
70.0	252	13
72.0	239	9
74.0	224	5
76.0	219	0

ASCN NODE 50. W.

ADD MINS	AZ	EL
60.0	313	1
62.0	304	4
64.0	292	7
66.0	279	9
68.0	265	9
70.0	252	8
72.0	240	5
74.0	238	2

ASCN NODE 55. W.

ADD MINS	AZ	EL
62.0	298	0
64.0	287	2
66.0	275	4
68.0	263	4
70.0	251	3
72.0	240	1

ASCN NODE 60. W.

ADD MINS	AZ	EL
66.0	272	0
68.0	261	0

ASCN NODE 160. W.

ADD MINS	AZ	EL
104.0	101	0
106.0	90	0

ASCN NODE 165. W.

ADD MINS	AZ	EL
100.0	122	1
102.0	111	3
104.0	99	4
106.0	87	4
108.0	75	3
110.0	64	1

ASCN NODE 170. W.

ADD MINS	AZ	EL
98.0	132	1
100.0	122	4
102.0	110	7
104.0	97	9
106.0	84	8
108.0	70	7
110.0	56	4
112.0	46	1

ASCN NODE 175. W.

ADD MINS	AZ	EL
96.0	142	0
98.0	134	6
100.0	123	8
102.0	110	12
104.0	95	14
106.0	79	14
108.0	64	12
110.0	51	9
112.0	41	4

ASCN NODE 180. W.

ADD MINS	AZ	EL
96.0	144	2
98.0	136	8
100.0	125	13
102.0	111	18
104.0	93	21
106.0	74	21
108.0	57	17
110.0	43	12
112.0	33	7
114.0	25	1

ASCN NODE 185. W.

ADD MINS	AZ	EL
96.0	146	5
98.0	139	11
100.0	128	18
102.0	112	28
104.0	91	29
106.0	67	29
108.0	47	23
110.0	33	16
112.0	23	9
114.0	16	3

ASCN NODE 190. W.

ADD MINS	AZ	EL
94.0	156	1
96.0	150	7
98.0	143	15
100.0	132	24
102.0	115	34
104.0	88	40
106.0	56	39
108.0	34	29
110.0	20	19
112.0	12	11
114.0	7	4

ASCN NODE 195. W.

ADD MINS	AZ	EL
94.0	157	3
96.0	154	10
98.0	148	18
100.0	141	31
102.0	123	44
104.0	82	55
106.0	38	47
108.0	17	43
110.0	7	21
112.0	1	11
114.0	357	4

ASCN NODE 200. W.

ADD MINS	AZ	EL
94.0	160	4
96.0	158	12
98.0	156	22
100.0	150	36
102.0	136	56
104.0	68	73
106.0	9	56
108.0	357	34
110.0	352	21
112.0	350	11
114.0	348	3

ASCN NODE 205. W.

ADD MINS	AZ	EL
94.0	164	6
96.0	164	14
98.0	164	25
100.0	165	41
102.0	170	60
104.0	317	81
106.0	336	52
108.0	338	32
110.0	339	19
112.0	339	10
114.0	339	2

ASCN NODE 210. W.

ADD MINS	AZ	EL
92.0	167	0
94.0	168	7
96.0	171	15
98.0	179	26
100.0	184	42
102.0	212	61
104.0	281	62
106.0	312	43
108.0	322	27
110.0	327	16
112.0	329	7
114.0	331	0

ASCN NODE 215. W.

ADD MINS	AZ	EL
92.0	170	1
94.0	173	8
96.0	177	16
98.0	189	26
100.0	201	39
102.0	233	50
104.0	274	46
106.0	296	33
108.0	310	22
110.0	317	12
112.0	321	5

ASCN NODE 220. W.

ADD MINS	AZ	EL
92.0	173	1
94.0	178	8
96.0	186	16
98.0	198	25
100.0	214	34
102.0	243	38
104.0	271	34
106.0	290	25
108.0	301	16
110.0	308	7
112.0	313	1

ASCN NODE 225. W.

ADD MINS	AZ	EL
94.0	176	2
96.0	182	8
98.0	191	15
100.0	205	22
102.0	224	29
104.0	247	29
106.0	266	24
108.0	284	17
110.0	294	11
112.0	301	4

ASCN NODE 230. W.

ADD MINS	AZ	EL
92.0	179	2
94.0	187	8
96.0	197	13
98.0	212	19
100.0	226	22
102.0	249	21
104.0	266	17
106.0	279	12
108.0	288	6
110.0	295	0

ASCN NODE 235. W.

ADD MINS	AZ	EL
92.0	183	2
94.0	192	7
96.0	203	11
98.0	217	15
100.0	232	16
102.0	250	15
104.0	264	11
106.0	275	5
108.0	284	0

ASCN NODE 240. W.

ADD MINS	AZ	EL
92.0	186	1
94.0	196	6
96.0	206	8
98.0	221	11
100.0	236	11
102.0	250	9
104.0	262	6
106.0	272	2

ASCN NODE 245. W.

ADD MINS	AZ	EL
92.0	189	1
94.0	199	4
96.0	211	7
98.0	224	6
100.0	237	7
102.0	250	5
104.0	260	1

ASCN NODE 250. W.

ADD MINS	AZ	EL
92.0	192	0
94.0	203	3
96.0	214	4
98.0	226	4
100.0	238	3
102.0	249	1

ASCN NODE 255. W.

ADD MINS	AZ	EL
94.0	205	1
96.0	217	1
98.0	221	1

ASCN NODE 325. W.

ADD MINS	AZ	EL
74.0	131	1
76.0	141	1
78.0	153	1
80.0	163	0

ASCN NODE 330. W.

ADD MINS	AZ	EL
70.0	109	0
72.0	120	2
74.0	131	4
76.0	144	4
78.0	156	3
80.0	168	1

ASCN NODE 335. W.

ADD MINS	AZ	EL
68.0	96	1
70.0	106	4
72.0	120	6
74.0	133	7
76.0	146	7
78.0	159	5
80.0	169	2

ASCN NODE 340. W.

ADD MINS	AZ	EL
66.0	87	1
68.0	96	5
70.0	108	9
72.0	121	11
74.0	136	11
76.0	150	10
78.0	162	6
80.0	172	2

ASCN NODE 345. W.

ADD MINS	AZ	EL
64.0	75	1
66.0	83	5
68.0	94	10
70.0	106	14
72.0	124	16
74.0	140	15
76.0	155	12
78.0	167	6
80.0	176	3

ASCN NODE 350. W.

ADD MINS	AZ	EL
64.0	70	5
66.0	75	11
68.0	90	16
70.0	108	20
72.0	127	22
74.0	149	19
76.0	168	14
78.0	171	9
80.0	179	2

ASCN NODE 355. W.

ADD MINS	AZ	EL
62.0	58	3
64.0	65	9
66.0	75	16
68.0	89	22
70.0	109	28
72.0	132	28
74.0	152	22
76.0	167	16
78.0	178	9
80.0	183	2

ASCN NODE 360. W.

ADD MINS	AZ	EL
60.0	46	0
62.0	51	7
64.0	58	14
66.0	68	24
68.0	85	32
70.0	112	38
72.0	141	35
74.0	162	26
76.0	174	17
78.0	181	9
80.0	186	2

ASCN NODE 0. W.

ADD MINS	AZ	EL

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ASCN NODE 0. W.

ADD MINS	AZ	EL
62.0	28	5
64.0	29	13
66.0	31	28
68.0	35	38
70.0	47	58
72.0	132	76
74.0	182	55
76.0	191	33
78.0	194	20
80.0	195	10
82.0	196	3

ASCN NODE 5. W.

ADD MINS	AZ	EL
60.0	19	0
62.0	18	6
64.0	18	15
66.0	17	26
68.0	16	43
70.0	7	60
72.0	221	77
74.0	204	49
76.0	201	31
78.0	200	15
80.0	199	9
82.0	198	2

ASCN NODE 10. W.

ADD MINS	AZ	EL
60.0	11	3
62.0	9	7
64.0	6	16
66.0	1	27
68.0	351	43
70.0	328	53
72.0	249	62
74.0	219	43
76.0	210	27
78.0	205	16
80.0	202	7
82.0	201	0

ASCN NODE 15. W.

ADD MINS	AZ	EL
60.0	2	1
62.0	359	8
64.0	354	16
66.0	345	26
68.0	300	39
70.0	296	51
72.0	254	40
74.0	229	35
76.0	216	23
78.0	209	14
80.0	204	6

ASCN NODE 20. W.

ADD MINS	AZ	EL
60.0	353	1
62.0	349	7
64.0	342	15
66.0	331	26
68.0	314	33
70.0	286	39
72.0	256	37
74.0	234	28
76.0	221	19
78.0	212	11
80.0	206	6

ASCN NODE 25. W.

ADD MINS	AZ	EL
60.0	345	0
62.0	339	5
64.0	331	13
66.0	319	22
68.0	302	26
70.0	280	30
72.0	258	28
74.0	237	22
76.0	224	15
78.0	215	8
80.0	208	2

ASCN NODE 30. W.

ADD MINS	AZ	EL
62.0	338	4
64.0	321	10
66.0	309	15
68.0	294	20
70.0	279	22
72.0	255	21
74.0	239	17
76.0	226	11
78.0	217	5
80.0	209	0

ASCN NODE 35. W.

ADD MINS	AZ	EL
62.0	322	2
64.0	313	7
66.0	301	11
68.0	287	14
70.0	271	16
72.0	255	15
74.0	240	12
76.0	225	8
78.0	214	3

ASCN NODE 40. W.

ADD MINS	AZ	EL
64.0	305	3
66.0	294	7
68.0	282	10
70.0	268	11
72.0	252	10
74.0	240	8
76.0	225	4
78.0	219	1

ASCN NODE 45. W.

ADD MINS	AZ	EL
66.0	299	0
68.0	289	3
70.0	277	5
72.0	265	5
74.0	252	5
76.0	240	4
78.0	224	1

ASCN NODE 50. W.

ADD MINS	AZ	EL
66.0	273	1
70.0	262	2
72.0	250	2
74.0	239	1

ASCN NODE 150. W.

ADD MINS	AZ	EL
101.0	112	0
102.0	101	0

ASCN NODE 155. W.

ADD MINS	AZ	EL
96.0	133	0
98.0	122	2
100.0	111	3
102.0	99	4
104.0	87	3
106.0	76	2

ASCN NODE 160. W.

ADD MINS	AZ	EL
96.0	131	2
98.0	122	5
100.0	110	7
102.0	96	5
104.0	85	6
106.0	71	5
108.0	60	2

ASCN NODE 165. W.

ADD MINS	AZ	EL
94.0	143	1
96.0	134	5
98.0	122	9
100.0	109	12
102.0	96	13
104.0	78	12
106.0	65	10
108.0	53	6
110.0	43	1

ASCN NODE 170. W.

ADD MINS	AZ	EL
94.0	146	2
96.0	135	6
98.0	123	13
100.0	104	17
102.0	90	19
104.0	73	16
106.0	57	14
108.0	45	9
110.0	30	4

ASCN NODE 175. W.

ADD MINS	AZ	EL
92.0	152	5
94.0	145	6
96.0	137	12
98.0	124	18
100.0	108	23
102.0	87	26
104.0	66	24
106.0	49	19
108.0	36	12
110.0	27	6
112.0	26	0

ASCN NODE 180. W.

ADD MINS	AZ	EL
92.0	154	2
94.0	140	8
96.0	130	15
98.0	127	22
100.0	104	31
102.0	82	34
104.0	56	31
106.0	38	23
108.0	26	15
110.0	18	8
112.0	12	1

ASCN NODE 185. W.

ADD MINS	AZ	EL
92.0	196	3
94.0	190	11
96.0	140	19
98.0	131	30
100.0	110	40
102.0	79	45
104.0	43	38
106.0	24	27
108.0	14	17
110.0	7	9
112.0	3	2

ASCN NODE 190. W.

ADD MINS	AZ	EL
92.0	197	5
94.0	194	13
96.0	140	23
98.0	130	36
100.0	115	52
102.0	63	54
104.0	35	40
106.0	9	29
108.0	1	18
110.0	357	9
112.0	354	2

ASCN NODE 195. W.

ADD MINS	AZ	EL
90.0	161	5
92.0	160	7
94.0	158	15
96.0	155	26
98.0	140	43
100.0	124	60
102.0	30	71
104.0	359	57
106.0	352	38
108.0	349	17
110.0	347	8
112.0	345	1

ASCN NODE 200. W.

ADD MINS	AZ	EL
90.0	163	1
92.0	163	8
94.0	163	17
96.0	166	29
98.0	165	44
100.0	177	79
102.0	327	70
104.0	336	44
106.0	336	27
108.0	337	16
110.0	337	7
112.0	337	0

ASCN NODE 205. W.

ADD MINS	AZ	EL
90.0	165	2
92.0	166	9
94.0	169	19
96.0	174	31
98.0	185	49
100.0	229	67
102.0	296	57
104.0	316	38
106.0	323	23
108.0	326	13
110.0	324	5

ASCN NODE 210. W.

ADD MINS	AZ	EL
90.0	167	3
92.0	170	10
94.0	175	19
96.0	184	31
98.0	204	49
100.0	249	53
102.0	286	44
104.0	303	30
106.0	312	19
108.0	317	10
110.0	325	3

ASCN NODE 215. W.

ADD MINS	AZ	EL
90.0	169	4
92.0	174	11
94.0	182	20
96.0	194	30
98.0	217	39
100.0	248	41
102.0	277	34
104.0	294	23
106.0	303	14
108.0	309	6
110.0	312	0

ASCN NODE 220. W.

ADD MINS	AZ	EL
90.0	172	4
92.0	178	11
94.0	188	19
96.0	203	27
98.0	226	33
100.0	252	32
102.0	273	25
104.0	287	17
106.0	296	10
108.0	302	3

ASCN NODE 225. W.

ADD MINS	AZ	EL
90.0	175	5
92.0	183	11
94.0	194	18
96.0	210	24
98.0	231	26
100.0	252	24
102.0	269	18
104.0	281	12
106.0	290	6
108.0	296	0

ASCN NODE 230. W.

ADD MINS	AZ	EL
88.0	170	0
90.0	177	5
92.0	187	11
94.0	199	16
96.0	216	20
98.0	238	21
100.0	252	18
102.0	266	13
104.0	277	7
106.0	289	2

ASCN NODE 235. W.

ADD MINS	AZ	EL
88.0	172	0
90.0	180	5
92.0	191	10
94.0	204	14
96.0	220	16
98.0	237	15
100.0	251	12
102.0	264	6
104.0	273	3

ASCN NODE 240. W.

ADD MINS	AZ	EL
88.0	174	1
90.0	184	5
92.0	194	9
94.0	208	12
96.0	225	13
98.0	236	11
100.0	250	8
102.0	261	4

ASCN NODE 245. W.

ADD MINS	AZ	EL
88.0	176	1
90.0	184	5
92.0	190	8
94.0	211	9
96.0	229	9
98.0	238	7
100.0	240	4
102.0	259	0

ASCN NODE 250. W.

ADD MINS	AZ	EL
88.0	176	1
90.0	188	4
92.0	201	6
94.0	214	7
96.0	226	6
98.0	238	3
100.0	248	0

ASCN NODE 255. W.

ADD MINS	AZ	EL
88.0	180	1
90.0	191	4
92.0	203	5
94.0	219	5
96.0	227	3
98.0	237	0

ASCN NODE 260. W.

ADD MINS	AZ	EL
88.0	182	1
90.0	193	3
92.0	209	3
94.0	217	2
96.0	227	0

ASCN NODE 265. W.

ADD MINS	AZ	EL
88.0	184	1
90.0	199	2
92.0	207	1
94.0	218	0

ASCN NODE 270. W.

ADD MINS	AZ	EL
86.0	179	0
88.0	186	1
90.0	197	1
92.0	206	0

ASCN NODE 275. W.

ADD MINS	AZ	EL
86.0	177	0
88.0	186	0
90.0	199	0

ASCN NODE 280. W.

ADD MINS	AZ	EL
86.0	179	0
88.0	195	0

ASCN NODE 285. W.

ADD MINS	AZ	EL
84.0	169	0
86.0	188	0

ASCN NODE 290. W.

ADD MINS	AZ	EL
82.0	160	0
84.0	171	1
86.0	182	0

ASCN NODE 295. W.

ADD MINS	AZ	EL
80.0	151	0
82.0	162	1
84.0	173	1
86.0	184	0

ASCN NODE 300. W.

ADD MINS	AZ	EL
78.0	141	1
80.0	152	2
82.0	164	2
84.0	176	2
86.0	186	0

ASCN NODE 305. W.

ADD MINS	AZ	EL
76.0	131	1
78.0	142	3
80.0	154	4
82.0	166	4
84.0	177	2

ASCN NODE 310. W.

ADD MINS	AZ	EL
74.0	121	1
76.0	131	4
78.0	143	6
80.0	156	6
82.0	168	4
84.0	179	2

ASCN NODE 315. W.

ADD MINS	AZ	EL
72.0	110	1
74.0	120	5
76.0	132	7
78.0	146	8
80.0	159	7
82.0	171	5
84.0	181	2

ASCN NODE 320. W.

ADD MINS	AZ	EL
70.0	99	1
72.0	108	5
74.0	121	9
76.0	133	11
78.0	148	11
80.0	162	9
82.0	174	6
84.0	184	2

ASCN NODE 325. W.

ADD MINS	AZ	EL
68.0	88	0
70.0	96	5
72.0	107	9
74.0	120	13
76.0	136	15
78.0	151	13
80.0	165	10
82.0	177	6
84.0	186	1

ASCN NODE 330. W.

ADD MINS	AZ	EL
68.0	84	4
70.0	93	9
72.0	106	14
74.0	121	15
76.0	139	18
78.0	155	16
80.0	169	11
82.0	180	6
84.0	190	1

ASCN NODE 335. W.

ADD MINS	AZ	EL
66.0	72	3
68.0	79	8
70.0	90	14
72.0	105	20
74.0	123	23
76.0	143	22
78.0	161	18
80.0	174	12
82.0	183	6
84.0	189	0

ASCN NODE 340. W.

ADD MINS	AZ	EL
64.0	61	0
66.0	66	6
68.0	74	15
70.0	86	20
72.0	104	27
74.0	127	29
76.0	149	26
78.0	167	20
80.0	178	13
82.0	188	6
84.0	191	0

ASCN NODE 345. W.

ADD MINS	AZ	EL
64.0	54	4
66.0	60	11
68.0	68	19
70.0	82	28
72.0	104	35
74.0	130	37
76.0	158	33
78.0	172	21
80.0	182	13
82.0	189	5

ASCN NODE 350. W.

ADD MINS	AZ	EL
62.0	46	0
64.0	47	7
66.0	52	16
68.0	60	25
70.0	76	37
72.0	105	46
74.0	143	44
76.0	168	33
78.0	180	21
80.0	187	12
82.0	191	5

ASCN NODE 355. W.

ADD MINS	AZ	EL
62.0	34	3
64.0	38	11
66.0	42	19
68.0	51	31
70.0	66	40
72.0	110	48
74.0	158	51
76.0	179	34
78.0	187	21
80.0	191	11
82.0	194	4

ASCN NODE 360. W.

ADD MINS	AZ	EL
62.0	26	5
64.0	29	12
66.0	31	23
68.0	35	38
70.0	47	60
72.0	132	76
74.0	182	53
76.0	191	33
78.0	194	20
80.0	195	10
82.0	196	5

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ASCN NODE 0. W.

ADD MINS	AZ	EL
58.0	25	1
60.0	26	8
62.0	28	17
64.0	31	30
66.0	38	47
68.0	71	71
70.0	165	65
72.0	184	42
74.0	190	26
76.0	192	15
78.0	193	8

ASCN NODE 5. W.

ADD MINS	AZ	EL
58.0	17	3
60.0	16	10
62.0	15	20
64.0	13	33
66.0	9	54
68.0	338	82
70.0	209	62
72.0	202	39
74.0	200	24
76.0	198	13
78.0	198	5

ASCN NODE 10. W.

ADD MINS	AZ	EL
58.0	7	4
60.0	5	11
62.0	1	21
64.0	353	34
66.0	336	52
68.0	283	64
70.0	232	51
72.0	215	33
74.0	208	21
76.0	204	11
78.0	201	3

ASCN NODE 15. W.

ADD MINS	AZ	EL
58.0	358	4
60.0	354	11
62.0	347	20
64.0	335	31
66.0	312	43
68.0	275	47
70.0	242	39
72.0	224	27
74.0	215	17
76.0	209	9
78.0	204	2

ASCN NODE 20. W.

ADD MINS	AZ	EL
58.0	349	3
60.0	342	10
62.0	333	18
64.0	320	26
66.0	298	33
68.0	271	35
70.0	247	29
72.0	230	21
74.0	220	13
76.0	212	6
78.0	207	0

ASCN NODE 25. W.

ADD MINS	AZ	EL
58.0	340	2
60.0	332	8
62.0	322	14
64.0	308	20
66.0	290	25
68.0	268	25
70.0	249	21
72.0	234	15
74.0	223	9
76.0	215	3

ASCN NODE 30. W.

ADD MINS	AZ	EL
58.0	331	0
60.0	323	5
62.0	313	10
64.0	300	15
66.0	283	17
68.0	266	17
70.0	250	15
72.0	237	11
74.0	226	6
76.0	218	1

ASCN NODE 35. W.

ADD MINS	AZ	EL
60.0	316	2
62.0	305	6
64.0	293	9
66.0	279	11
68.0	264	11
70.0	250	9
72.0	238	6
74.0	228	2

ASCN NODE 40. W.

ADD MINS	AZ	EL
62.0	299	2
64.0	288	5
66.0	275	6
68.0	262	6
70.0	250	4
72.0	239	2

ASCN NODE 45. W.

ADD MINS	AZ	EL
64.0	283	0
66.0	272	1
68.0	261	1
70.0	249	0

ASCN NODE 150. W.

ADD MINS	AZ	EL
102.0	112	1
104.0	101	2
106.0	90	2
108.0	78	1

ASCN NODE 155. W.

ADD MINS	AZ	EL
100.0	123	2
102.0	112	5
104.0	100	6
106.0	87	7
108.0	74	5
110.0	63	3
112.0	52	0

ASCN NODE 160. W.

ADD MINS	AZ	EL
98.0	134	2
100.0	124	6
102.0	112	9
104.0	96	12
106.0	83	12
108.0	69	10
110.0	56	7
112.0	46	3

ASCN NODE 165. W.

ADD MINS	AZ	EL
96.0	144	0
98.0	136	5
100.0	126	10
102.0	113	15
104.0	97	18
106.0	79	18
108.0	62	16
110.0	48	12
112.0	38	7
114.0	29	1

ASCN NODE 170. W.

ADD MINS	AZ	EL
96.0	146	3
98.0	139	9
100.0	128	15
102.0	114	21
104.0	95	25
106.0	73	26
108.0	54	22
110.0	39	16
112.0	28	9
114.0	21	3

ASCN NODE 175. W.

ADD MINS	AZ	EL
96.0	149	5
98.0	142	12
100.0	132	20
102.0	117	29
104.0	93	35
106.0	65	35
108.0	43	28
110.0	27	20
112.0	18	12
114.0	11	5

ASCN NODE 180. W.

ADD MINS	AZ	EL
94.0	157	1
96.0	153	8
98.0	147	16
100.0	136	26
102.0	122	38
104.0	92	48
106.0	52	46
108.0	27	34
110.0	14	22
112.0	6	13
114.0	2	5

ASCN NODE 185. W.

ADD MINS	AZ	EL
94.0	160	2
96.0	157	10
98.0	153	19
100.0	147	31
102.0	133	49
104.0	89	65
106.0	27	56
108.0	7	37
110.0	359	23
112.0	355	13
114.0	352	5

ASCN NODE 190. W.

ADD MINS	AZ	EL
94.0	163	4
96.0	162	12
98.0	161	22
100.0	160	36
102.0	156	58
104.0	73	86
106.0	349	58
108.0	345	36
110.0	344	22
112.0	343	12
114.0	343	4

ASCN NODE 195. W.

ADD MINS	AZ	EL
94.0	167	5
96.0	168	13
98.0	171	24
100.0	176	39
102.0	192	64
104.0	272	72
106.0	317	50
108.0	327	32
110.0	330	19
112.0	332	10
114.0	334	2

ASCN NODE 200. W.

ADD MINS	AZ	EL
94.0	171	6
96.0	175	14
98.0	181	24
100.0	193	38
102.0	221	52
104.0	259	53
106.0	306	39
108.0	313	26
110.0	319	15
112.0	323	7
114.0	326	0

ASCN NODE 205. W.

ADD MINS	AZ	EL
92.0	172	0
94.0	176	7
96.0	181	14
98.0	191	24
100.0	207	34
102.0	235	41
104.0	267	39
106.0	290	29
108.0	302	19
110.0	310	11
112.0	315	4

ASCN NODE 210. W.

ADD MINS	AZ	EL
92.0	175	1
94.0	180	7
96.0	189	14
98.0	206	22
100.0	218	29
102.0	242	32
104.0	265	28
106.0	283	21
108.0	295	14
110.0	303	7
112.0	308	0

ASCN NODE 215. W.

ADD MINS	AZ	EL
92.0	178	1
94.0	185	7
96.0	194	13
98.0	207	19
100.0	225	22
102.0	249	23
104.0	264	20
106.0	278	14
108.0	289	8
110.0	297	3

ASCN NODE 220. W.

ADD MINS	AZ	EL
92.0	181	1
94.0	189	6
96.0	200	11
98.0	214	15
100.0	230	17
102.0	247	17
104.0	262	13
106.0	275	9
108.0	284	4

ASCN NODE 225. W.

ADD MINS	AZ	EL
92.0	184	1
94.0	193	5
96.0	205	9
98.0	218	12
100.0	233	12
102.0	248	11
104.0	261	8
106.0	271	4

ASCN NODE 230. W.

ADD MINS	AZ	EL
92.0	188	0
94.0	197	4
96.0	209	7
98.0	222	8
100.0	235	8
102.0	248	6
104.0	259	3
106.0	269	0

ASCN NODE 235. W.

ADD MINS	AZ	EL
92.0	191	0
94.0	201	2
96.0	212	4
98.0	224	5
100.0	237	4
102.0	248	2

ASCN NODE 240. W.

ADD MINS	AZ	EL
94.0	204	1
96.0	215	2
98.0	226	2
100.0	237	0

ASCN NODE 315. W.

ADD MINS	AZ	EL
72.0	121	0
74.0	132	2
76.0	143	2
78.0	155	1

ASCN NODE 320. W.

ADD MINS	AZ	EL
70.0	110	2
72.0	121	4
74.0	134	5
76.0	148	5
78.0	158	3
80.0	168	0

ASCN NODE 325. W.

ADD MINS	AZ	EL
68.0	99	3
70.0	110	6
72.0	123	8
74.0	136	9
76.0	149	7
78.0	161	4
80.0	171	1

ASCN NODE 330. W.

ADD MINS	AZ	EL
66.0	87	4
68.0	97	8
70.0	110	11
72.0	124	13
74.0	140	12
76.0	153	10
78.0	165	6
80.0	174	1

ASCN NODE 335. W.

ADD MINS	AZ	EL
64.0	74	3
66.0	83	8
68.0	95	13
70.0	110	17
72.0	127	18
74.0	144	16
76.0	158	12
78.0	170	7
80.0	178	2

ASCN NODE 340. W.

ADD MINS	AZ	EL
62.0	62	2
64.0	69	8
66.0	79	14
68.0	92	20
70.0	111	24
72.0	132	24
74.0	150	20
76.0	164	14
78.0	174	8
80.0	181	2

ASCN NODE 345. W.

ADD MINS	AZ	EL
60.0	54	2
62.0	56	6
64.0	63	13
66.0	74	21
68.0	91	28
70.0	114	32
72.0	139	30
74.0	158	23
76.0	171	15
78.0	179	8
80.0	185	2

ASCN NODE 350. W.

ADD MINS	AZ	EL
60.0	44	3
62.0	48	10
64.0	55	18
66.0	67	28
68.0	88	39
70.0	120	43
72.0	150	36
74.0	168	26
76.0	178	16
78.0	184	8
80.0	188	1

ASCN NODE 355. W.

ADD MINS	AZ	EL
60.0	36	6
62.0	39	14
64.0	45	24
66.0	56	38
68.0	83	53
70.0	133	55
72.0	166	41
74.0	179	27
76.0	185	16
78.0	189	7
80.0	191	2

ASCN NODE 360. W.

ADD MINS	AZ	EL
58.0	25	1
60.0	26	8
62.0	28	17
64.0	31	30
66.0	38	47
68.0	71	71
70.0	165	65
72.0	184	42
74.0	190	26
76.0	192	15
78.0	193	8

ASCN NODE 0. W.

ADD MINS	AZ	EL

ASCN NODE 0. W.

ADD MINS	AZ	EL

ASCN NODE 0. W.

ADD MINS	AZ	EL

MELBOURNE

ASCN NODE 0. W.

ADD MINS	AZ	EL
60.0	35	1
62.0	37	8
64.0	41	17
66.0	48	28
68.0	62	43
70.0	97	57
72.0	140	53
74.0	173	37
76.0	183	23
78.0	188	13
80.0	191	5

ASCN NODE 5. W.

ADD MINS	AZ	EL
60.0	27	3
62.0	28	11
64.0	30	20
66.0	33	34
68.0	43	54
70.0	101	75
72.0	179	56
74.0	188	37
76.0	192	22
78.0	194	12
80.0	196	4

ASCN NODE 10. W.

ADD MINS	AZ	EL
60.0	18	5
62.0	17	13
64.0	16	23
66.0	14	38
68.0	9	62
70.0	247	83
72.0	205	55
74.0	201	34
76.0	199	20
78.0	198	11
80.0	197	3

ASCN NODE 15. W.

ADD MINS	AZ	EL
60.0	8	6
62.0	5	14
64.0	1	24
66.0	352	39
68.0	320	56
70.0	263	64
72.0	224	46
74.0	212	30
76.0	206	18
78.0	203	9
80.0	200	2

ASCN NODE 20. W.

ADD MINS	AZ	EL
60.0	356	6
62.0	353	14
64.0	346	24
66.0	332	36
68.0	309	47
70.0	263	48
72.0	244	37
74.0	229	25
76.0	221	15
78.0	215	7
80.0	212	0

ASCN NODE 25. W.

ADD MINS	AZ	EL
60.0	348	5
62.0	342	13
64.0	332	21
66.0	316	30
68.0	292	36
70.0	263	36
72.0	248	29
74.0	229	20
76.0	216	12
78.0	209	5

ASCN NODE 30. W.

ADD MINS	AZ	EL
60.0	339	4
62.0	331	10
64.0	320	17
66.0	305	23
68.0	284	27
70.0	262	26
72.0	243	22
74.0	229	15
76.0	219	9
78.0	211	3

ASCN NODE 35. W.

ADD MINS	AZ	EL
60.0	330	2
62.0	322	8
64.0	311	13
66.0	296	17
68.0	279	20
70.0	260	19
72.0	244	16
74.0	231	11
76.0	221	5
78.0	213	0

ASCN NODE 40. W.

ADD MINS	AZ	EL
60.0	322	0
62.0	314	5
64.0	303	9
66.0	290	12
68.0	275	13
70.0	259	13
72.0	245	10
74.0	235	7
76.0	227	3

ASCN NODE 45. W.

ADD MINS	AZ	EL
62.0	307	1
64.0	298	5
66.0	284	7
68.0	271	8
70.0	258	8
72.0	245	6
74.0	234	3
76.0	224	0

ASCN NODE 50. W.

ADD MINS	AZ	EL
64.0	291	1
66.0	280	3
68.0	269	4
70.0	256	3
72.0	245	2
74.0	234	0

ASCN NODE 155. W.

ADD MINS	AZ	EL
102.0	107	1
104.0	96	1
106.0	85	0

ASCN NODE 160. W.

ADD MINS	AZ	EL
98.0	128	0
100.0	117	3
102.0	106	5
104.0	93	5
106.0	81	4
108.0	69	2
110.0	59	0

ASCN NODE 165. W.

ADD MINS	AZ	EL
96.0	130	0
98.0	128	4
100.0	117	7
102.0	104	9
104.0	90	10
106.0	76	9
108.0	64	6
110.0	53	3

ASCN NODE 170. W.

ADD MINS	AZ	EL
96.0	139	3
98.0	130	7
100.0	118	11
102.0	103	14
104.0	87	15
106.0	71	14
108.0	57	11
110.0	46	6
112.0	36	1

ASCN NODE 175. W.

ADD MINS	AZ	EL
94.0	148	0
96.0	141	5
98.0	132	11
100.0	119	17
102.0	102	21
104.0	83	22
106.0	64	20
108.0	49	15
110.0	37	10
112.0	28	4

ASCN NODE 180. W.

ADD MINS	AZ	EL
94.0	150	2
96.0	144	8
98.0	134	15
100.0	121	22
102.0	102	29
104.0	78	30
106.0	56	27
108.0	39	20
110.0	27	12
112.0	19	6
114.0	12	0

ASCN NODE 185. W.

ADD MINS	AZ	EL
94.0	153	4
96.0	147	11
98.0	139	20
100.0	125	29
102.0	102	38
104.0	70	41
106.0	43	36
108.0	26	24
110.0	16	15
112.0	9	7
114.0	5	0

ASCN NODE 190. W.

ADD MINS	AZ	EL
92.0	159	0
94.0	156	6
96.0	151	14
98.0	144	24
100.0	132	37
102.0	104	51
104.0	67	53
106.0	29	40
108.0	11	26
110.0	4	16
112.0	359	7
114.0	356	0

ASCN NODE 195. W.

ADD MINS	AZ	EL
92.0	161	1
94.0	159	8
96.0	157	17
98.0	152	29
100.0	144	46
102.0	112	67
104.0	37	64
106.0	2	45
108.0	355	27
110.0	351	15
112.0	349	7
114.0	348	0

ASCN NODE 200. W.

ADD MINS	AZ	EL
92.0	164	2
94.0	163	10
96.0	163	19
98.0	163	32
100.0	164	52
102.0	173	82
104.0	337	65
106.0	339	41
108.0	339	29
110.0	339	14
112.0	339	6

ASCN NODE 205. W.

ADD MINS	AZ	EL
92.0	166	3
94.0	168	11
96.0	170	21
98.0	176	34
100.0	190	55
102.0	246	69
104.0	308	54
106.0	320	35
108.0	324	21
110.0	329	11
112.0	330	4

ASCN NODE 210. W.

ADD MINS	AZ	EL
92.0	169	4
94.0	173	12
96.0	178	21
98.0	189	34
100.0	212	48
102.0	256	53
104.0	291	42
106.0	307	28
108.0	315	17
110.0	319	8
112.0	322	1

ASCN NODE 215. W.

ADD MINS	AZ	EL
92.0	173	5
94.0	178	12
96.0	187	21
98.0	201	31
100.0	225	40
102.0	250	40
104.0	283	31
106.0	297	21
108.0	306	12
110.0	311	5

ASCN NODE 220. W.

ADD MINS	AZ	EL
92.0	176	5
94.0	184	12
96.0	194	20
98.0	211	27
100.0	234	31
102.0	258	29
104.0	277	23
106.0	290	15
108.0	299	8
110.0	304	2

ASCN NODE 225. W.

ADD MINS	AZ	EL
90.0	174	0
92.0	180	4
94.0	189	12
96.0	201	18
98.0	218	23
100.0	238	24
102.0	258	21
104.0	273	16
106.0	284	10
108.0	293	4

ASCN NODE 230. W.

ADD MINS	AZ	EL
90.0	176	0
92.0	184	5
94.0	194	11
96.0	207	15
98.0	223	18
100.0	241	18
102.0	257	15
104.0	270	10
106.0	280	6
108.0	287	0

ASCN NODE 235. W.

ADD MINS	AZ	EL
90.0	179	0
92.0	187	3
94.0	198	9
96.0	212	12
98.0	227	14
100.0	242	13
102.0	256	10
104.0	267	6
106.0	276	1

ASCN NODE 240. W.

ADD MINS	AZ	EL
90.0	181	0
92.0	191	4
94.0	202	8
96.0	215	9
98.0	229	10
100.0	243	8
102.0	255	5
104.0	264	1

ASCN NODE 245. W.

ADD MINS	AZ	EL
90.0	184	0
92.0	194	3
94.0	208	6
96.0	216	7
98.0	231	6
100.0	243	4
102.0	253	1

ASCN NODE 250. W.

ADD MINS	AZ	EL
90.0	186	0
92.0	197	2
94.0	208	4
96.0	220	4
98.0	232	3
100.0	242	0

ASCN NODE 255. W.

ADD MINS	AZ	EL
92.0	199	1
94.0	210	2
96.0	222	1

ASCN NODE 260. W.

ADD MINS	AZ	EL
92.0	201	0

ASCN NODE 310. W.

ADD MINS	AZ	EL
78.0	147	0
80.0	156	0

ASCN NODE 315. W.

ADD MINS	AZ	EL
74.0	126	0
76.0	137	2
78.0	148	2
80.0	160	2
82.0	171	0

ASCN NODE 320. W.

ADD MINS	AZ	EL
72.0	116	1
74.0	126	3
76.0	138	5
78.0	151	4
80.0	162	3
82.0	173	0

ASCN NODE 325. W.

ADD MINS	AZ	EL
70.0	105	2
72.0	115	5
74.0	127	7
76.0	141	8
78.0	154	7
80.0	165	4
82.0	176	1

ASCN NODE 330. W.

ADD MINS	AZ	EL
68.0	93	2
70.0	103	6
72.0	115	9
74.0	129	11
76.0	143	11
78.0	157	9
80.0	169	5
82.0	178	1

ASCN NODE 335. W.

ADD MINS	AZ	EL
66.0	81	1
68.0	91	6
70.0	102	11
72.0	116	14
74.0	131	15
76.0	147	14
78.0	161	10
80.0	172	6
82.0	181	1

ASCN NODE 340. W.

ADD MINS	AZ	EL
64.0	70	0
66.0	77	6
68.0	87	11
70.0	100	16
72.0	117	20
74.0	135	20
76.0	152	17
78.0	166	12
80.0	176	6
82.0	184	1

ASCN NODE 345. W.

ADD MINS	AZ	EL
64.0	64	4
66.0	72	10
68.0	83	17
70.0	99	23
72.0	119	26
74.0	141	25
76.0	158	20
78.0	171	13
80.0	180	7
82.0	186	1

ASCN NODE 350. W.

ADD MINS	AZ	EL
62.0	53	2
64.0	58	8
66.0	66	16
68.0	78	24
70.0	98	31
72.0	124	34
74.0	149	30
76.0	166	22
78.0	177	14
80.0	184	6
82.0	189	0

ASCN NODE 355. W.

ADD MINS	AZ	EL
62.0	45	5
64.0	50	12
66.0	58	22
68.0	72	32
70.0	97	42
72.0	132	43
74.0	159	34
76.0	174	23
78.0	183	14
80.0	188	6

ASCN NODE 360. W.

ADD MINS	AZ	EL
60.0	35	1
62.0	37	8
64.0	41	17
66.0	48	28
68.0	62	43
70.0	97	57
72.0	140	53
74.0	173	37
76.0	183	23
78.0	188	13
80.0	191	5

ASCN NODE 0. W.

ADD MINS	AZ	EL

ASCN NODE 0. W.

ADD MINS	AZ	EL

ASCN NODE 0. W.

ADD MINS	AZ	EL

ASCN NODE 0. W.

ADD MINS	AZ	EL